

**IN THE UNITED STATES DISTRICT COURT  
FOR THE WESTERN DISTRICT OF TEXAS  
WACO DIVISION**

AMERICAN PATENTS LLC,

Plaintiff,

v.

SONIM TECHNOLOGIES, INC.,

Defendant.

CIVIL ACTION NO. 6:20-cv-781

ORIGINAL COMPLAINT FOR  
PATENT INFRINGEMENT

**JURY TRIAL DEMANDED**

**ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT**

Plaintiff American Patents LLC (“American Patents” or “Plaintiff”) files this original complaint against Defendant Sonim Technologies, Inc. (“Sonim”), alleging, based on its own knowledge as to itself and its own actions and based on information and belief as to all other matters, as follows:

**PARTIES**

1. American Patents is a limited liability company formed under the laws of the State of Texas, with its principal place of business at 2325 Oak Alley, Tyler, Texas, 75703.

2. Sonim Technologies, Inc. is a corporation organized and existing under the laws of Delaware. Sonim Technologies, Inc. may be served through its registered agent, C T Corporation System, at 1999 Bryan Street, Suite 900, Dallas, TX 75201.

**JURISDICTION AND VENUE**

3. This is an action for infringement of United States patents arising under 35 U.S.C. §§ 271, 281, and 284–85, among others. This Court has subject matter jurisdiction of the action under 28 U.S.C. § 1331 and § 1338(a).

4. This Court has personal jurisdiction over Sonim pursuant to due process and/or the Texas Long Arm Statute because, *inter alia*, (i) Sonim has done and continues to do business in Texas; (ii) Sonim has committed and continues to commit acts of patent infringement in the State of Texas, including making, using, offering to sell, and/or selling accused products in Texas, and/or importing accused products into Texas, including by Internet sales and sales via retail and wholesale stores, inducing others to commit acts of patent infringement in Texas, and/or committing a least a portion of any other infringements alleged herein; and (iii) Sonim is registered to do business in Texas.

5. Venue is proper in this district as to Defendant Sonim Technologies, Inc. pursuant to 28 U.S.C. § 1400(b). Venue is further proper as to Sonim Technologies Inc. because Sonim Technologies Inc. has committed and continues to commit acts of patent infringement in this district, including making, using, offering to sell, and/or selling accused products in this district, and/or importing accused products into this district, including by Internet sales and sales via retail and wholesale stores, inducing others to commit acts of patent infringement in Texas, and/or committing at least a portion of any other infringements alleged herein in this district. Sonim Technologies Inc. has regular and established places of business in this district, including at least at 6836 FM 2244 Rd. (*aka* Bee Cave Rd.), Bldg 1-279, Austin, TX 78746:

SONIM TECHNOLOGIES, INC.	
<b>Texas Taxpayer Number</b>	19433367836
<b>Mailing Address</b>	6836 FM 2244 RD BLDG 1-279 AUSTIN, TX 78746-5062
<b>Right to Transact Business in Texas</b>	ACTIVE
<b>State of Formation</b>	DE
<b>Effective SOS Registration Date</b>	03/18/2020
<b>Texas SOS File Number</b>	0803577128
<b>Registered Agent Name</b>	C T CORPORATION SYSTEM
<b>Registered Office Street Address</b>	1999 BRYAN ST. SUITE 900 DALLAS, TX 75201

(Source: screenshot from search results downloaded from

<https://mycpa.cpa.state.tx.us/coa/coaSearchBtn#>)

©2020 Sonim Technologies Inc. All Rights Reserved. [Privacy Policy](#) | [Terms of Use](#) 6836 Bee Cave Road, Building 1, Suite 279, Austin, TX 78746, USA  
Telephone: 1-650-378-8100 | Fax: 1-650-378-8109 | Support: 1-833-MY-SONIM (1-833-697-6646)

(Source: <https://www.sonimtech.com>)

### **BACKGROUND**

6. The patents-in-suit generally pertain to communications networks and other technology used in “smart” devices such as smartphones, smart TVs, and smart appliances. The technology disclosed by the patents was developed by personnel at Georgia Institute of Technology (“Georgia Tech”), Nokia Corporation (“Nokia”), and AT&T Mobility.

7. Georgia Tech is a leading public research university located in Atlanta, Georgia. Founded in 1885, Georgia Tech is often ranked as one of the top ten public universities in the United States. The patents from Georgia Tech (“the Mody patents”) were developed by a professor and a graduate student in Georgia Tech’s Electrical and Computer Engineering

department. The undergraduate and graduate programs of this department are often ranked in the top five of their respective categories.

8. The Mody patents are related to Multi-Input, Multi-Output (MIMO) technology. The inventors of the Mody patents were at the forefront of MIMO, developing, disclosing, and patenting a solution for achieving both time and frequency synchronization in MIMO systems. The Mody patents (or the applications leading to them) have been cited during patent prosecution hundreds of times, by numerous leading companies in the computing and communications industries, including AMD, Alcatel Lucent, Altair, AT&T, Atheros, Blackberry, Broadcom, Comcast, Ericsson, Facebook, HP, Hitachi, Huawei, Infineon, Intel, Interdigital, IBM, Kyocera, Marvell, Matsushita, Mediatek, Motorola, NEC, Nokia, Nortel Networks, NXP, Panasonic, Philips, Qualcomm, Realtek, Samsung, Sanyo, Sharp, Sony, STMicroelectronics, Texas Instruments, and Toshiba.

9. Nokia is a Finnish multinational telecommunications, IT, and consumer electronics company. Listed on both the Helsinki Stock Exchange and the New York Stock Exchange, Nokia regularly makes the Fortune Global 500. Nokia has been the largest worldwide vendor of mobile phones and smartphones and has been a major contributor to the mobile phone industry.

10. The patent developed at Nokia (“the Rauhala patent”) is related to reduction of interference in receivers with multiple antennas. The inventors of the Rauhala patent have a combined fifty plus years of experience at Nokia and were prolific inventors for Nokia. Inventor Jyri Rauhala spent over 25 years at Nokia. Mr. Rauhala obtained a Master of Science in Applied Electronics, Digital Electronics from Tampere University of Technology in Finland and is named as an inventor on 15 U.S. patents. Inventor Olli-Pekka Lunden spent over 8 years at Nokia. Dr.

Lunden obtained a Doctor of Science in Technology, Radio Engineering from Aalto University and is named as an inventor on 5 U.S. patents. Currently, Dr. Lunden works as a university lecturer at Tampere University of Technology in Finland. Inventor Marko Erkkila spent over twenty years at Nokia. Mr. Erkkila obtained a Master of Science in Digital Signal Processing, Electronics, Computer Science from Tampere University of Technology in Finland and is named as an inventor on 6 U.S. patents.

11. AT&T Mobility is the second largest provider of wireless services in the United States. AT&T Mobility and its parent company, AT&T Inc. have a rich history of invention and innovation. These companies can trace their roots back to the invention of the first telephone by Alexander Graham Bell in the 1870's. Since the time of Alexander Bell, AT&T (or Ma Bell as it was once called) has been a leader in the field of communications. In the 1890's AT&T built the first long distance telephone network in the United States. AT&T was instrumental throughout the 1900's in developing and innovating telephone networks. In the early 1980's, an AT&T company created the first cellular network in the United States. In the 1990s and 2000s, AT&T was at the forefront of the wireless revolution. In 2007 as part of a partnership with Apple, AT&T exclusively sold the original iPhone to its customers.

12. The patent developed at AT&T Mobility ("the Maria patent") is related to securing inbound and outbound data packet flow in computer networks. The inventor of the Maria patent, Arturo Maria, was a prolific inventor for AT&T. Indeed, Mr. Maria is named as the sole inventor on 45 U.S. patents.

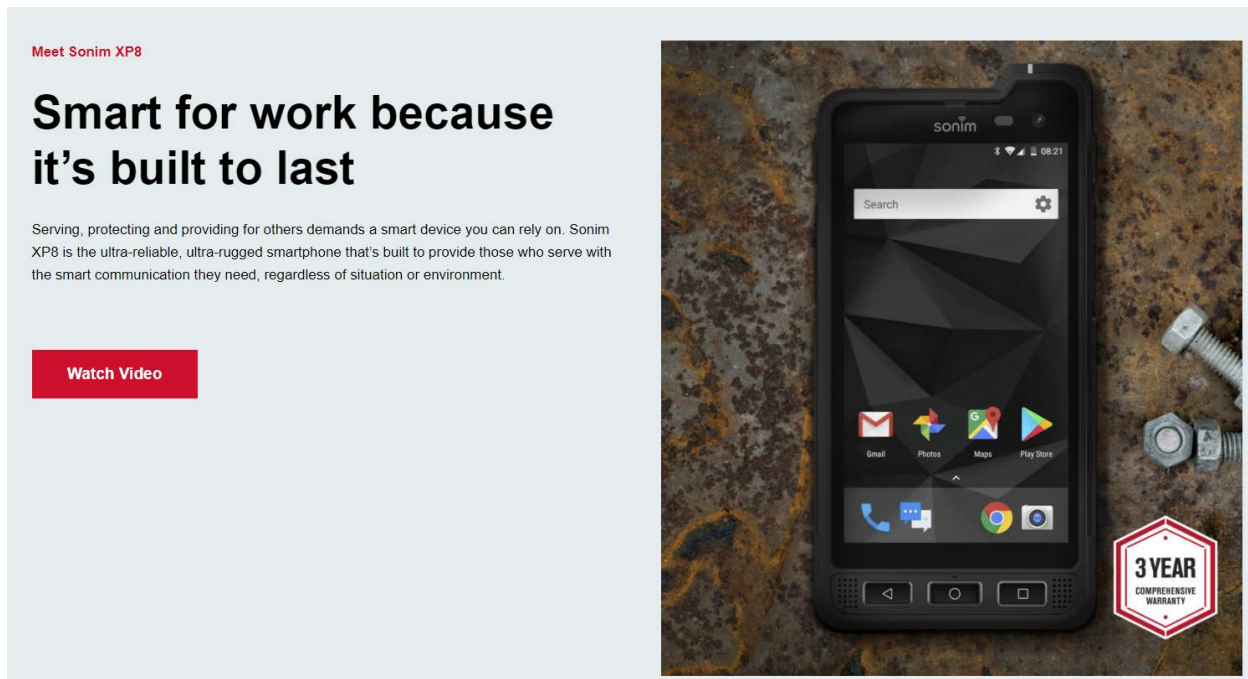
## COUNT I

### DIRECT INFRINGEMENT OF U.S. PATENT NO. 7,088,782

13. On August 8, 2006, United States Patent No. 7,088,782 (“the ‘782 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “Time And Frequency Synchronization In Multi-Input, Multi-Output (MIMO) Systems.”

14. American Patents is the owner of the ‘782 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ‘782 Patent against infringers, and to collect damages for all relevant times.

15. Sonim used products and/or systems including, for example, its Sonim XP8, Sonim XP7, Sonim XP5s, and Sonim XP3 families of products, that include LTE capabilities (“accused products”):



(Source: <https://www.sonimtech.com/products/devices/xp8/>)

## Antenna

MIMO antenna for LTE

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

## Sonim XP7

The Sonim XP7 is the cornerstone of Sonim's Mission Critical Solution. An ultra- rugged, LTE/WiFi/Android smartphone, the XP7 is outfitted with unrivaled features such as a touch screen that can be viewed in direct sunlight and easily used with dirty or wet work gloves.

An extra loud speaker, noise cancellation, powerful battery, resistance to drops and water and a 3-Year comprehensive warranty are just some features of the XP7 that provide peace of mind to enterprises and workers alike.

Access to vertical enterprise worker safety and productivity applications as well as a full suite of industrial-grade accessories completes the solution. In extreme and often dangerous working environments where every step is critical, you don't settle for less than the best – Sonim XP7.

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(Source : <https://www.sonimtech.com/products/devices/xp7/>)

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(Source : <https://www.sonimtech.com/products/devices/xp7/>)

Introducing the Sonim XP5s

## Handset communication pushed to the extreme

Meet the next generation ultra-rugged device built for mission critical communication. Industrial strength. Military tested. The XP5s meets the toughest performance standards to deliver clear, crisp communication wherever work takes you. With built-for-work features that ensure the job gets done right.

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(Source : <https://www.sonimtech.com/products/devices/xp5s/>)

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(Source : <https://www.sonimtech.com/products/devices/xp5s/>)




Introducing Sonim XP3

## Flip the script on handset durability.

In mission critical situations, getting the basics right is everything. And for fast, easy and reliable communication, the Sonim XP3 is as dependable as they come. FirstNet and B14 ready, Military rated and with Noise Cancellation, this ultra-rugged flip outperforms – in the most extreme conditions on earth.

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(Source : <https://www.sonimtech.com/products/devices/xp3/>)

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MIMO antenna for LTE

(Source : <https://www.sonimtech.com/products/devices/xp3/>)

16. By doing so, Sonim has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 30 of the ‘782 Patent. Sonim’s infringement in this regard is ongoing.

17. Sonim has infringed the ‘782 Patent by using the accused products and thereby practicing a method for synchronizing a Multi-Input Multi-Output (MIMO) Orthogonal Frequency Division Multiplexing (OFDM) system in time and frequency domains. For example, the accused products support the LTE standard and MIMO technology. According to the LTE standards, the physical layer performs various functions which include modulation and demodulation of physical channels as well as time and frequency synchronization.

Meet Sonim XP8

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Serving, protecting and providing for others demands a smart device you can rely on. Sonim XP8 is the ultra-reliable, ultra-rugged smartphone that's built to provide those who serve with the smart communication they need, regardless of situation or environment.

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A black Sonim XP5s rugged smartphone is shown vertically on a dark, textured surface. The screen displays the time 04:05 PM, the date Fri, September 22, and a red emergency call icon. Below the screen is a physical keypad with a central navigation pad and a numeric keypad. The Sonim logo is visible below the screen. To the right of the phone is a red and white badge that reads "3 YEAR COMPREHENSIVE WARRANTY".

(Source : <https://www.sonimtech.com/products/devices/xp5s/>)

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MIMO antenna for LTE

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(Source : <https://www.sonimtech.com/products/devices/xp3/>)

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MIMO antenna for LTE

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## 5.2 Overview of L1 functions

The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

- Error detection on the transport channel and indication to higher layers
- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
- Radio characteristics measurements and indication to higher layers
- Multiple Input Multiple Output (MIMO) antenna processing
- Transmit Diversity (TX diversity)
- Beamforming
- RF processing.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136300\\_136399/136302/15.00.00\\_60/ts\\_136302v150000p.pdf](https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/15.00.00_60/ts_136302v150000p.pdf))

### Synchronization Signals (PSS and SSS)

In LTE, there are two downlink synchronization signals which are used by the UE to obtain the cell identity and frame timing.

- Primary synchronization signal (PSS)
- Secondary synchronization signal (SSS)

The division into two signals is aimed to reduce the complexity of the cell search process.

(Source: <https://in.mathworks.com/help/lte/ug/synchronization-signals-pss-and-sss.html>)

18. The methods practiced by Sonim's use of the accused products include producing a frame of data comprising a training symbol that includes a synchronization component that aids in synchronization, a plurality of data symbols, and a plurality of cyclic prefixes. For example, the physical layer performs the modulation and demodulation of the physical channels. Further,

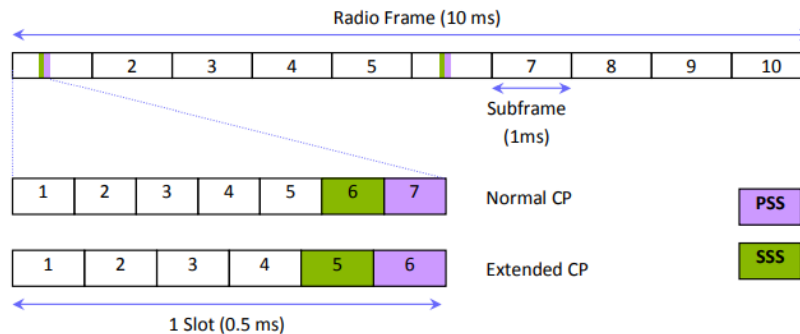


it uses OFDM in the downlink physical channel. Hence, there would be OFDM modulators present in transmitter of the apparatus (mobile devices such as the accused products) for modulating the data signals. The physical layer transmits downlink frames that include data symbols, pilot symbols such as PSS, SSS, reference symbols and cyclic prefixes for each symbol.

Synchronization signals are transmitted twice per 10 ms radio frame. The PSS is located in the last OFDM symbol of the first and 11<sup>th</sup> slot of each radio frame which allows the UE to acquire the slot boundary timing independent of the type of cyclic prefix length. The PSS signal is the same for any given cell in every subframe in which it is transmitted (the PSS uses a sequence known as Zadoff-Chu).

The location of the SSS immediately precedes the PSS – in the before to last symbol of the first and 11<sup>th</sup> slot of each radio frame. The UE would be able to determine the CP length by checking the absolute position of the SSS. The UE would also be able to determine the position of the 10 ms frame boundary as the SSS signal alternates in a specific manner between two transmissions (the SSS uses a sequence known as M-sequences).

In the frequency domain, the PSS and SSS occupy the central six resource blocks, irrespective of the system channel bandwidth, which allows the UE to synchronize to the network without a priori knowledge of the allocated bandwidth. The synchronization sequences use 62 sub-carriers in total, with 31 sub-carriers mapped on each side of the DC sub-carrier which is not used. This leaves 5 sub-carriers at each extremity of the 6 central RBs unused.



**FIGURE 8 SYNCHRONIZATION SIGNAL FRAME AND SLOT STRUCTURE IN TIME DOMAIN.**

(Source: <https://home.zhaw.ch/kunr/NTM1/literatur/LTE%20in%20a%20Nutshell%20-%20Physical%20Layer.pdf>)

#### 4.2.1 Multiple Access

The multiple access scheme for the LTE physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP) in the downlink, and on Single-Carrier Frequency Division Multiple Access (SC-FDMA) with a cyclic prefix in the uplink. To support transmission in paired and unpaired spectrum, two duplex modes

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf))

## 6.11.1 Primary synchronization signal

### 6.11.1.1 Sequence generation

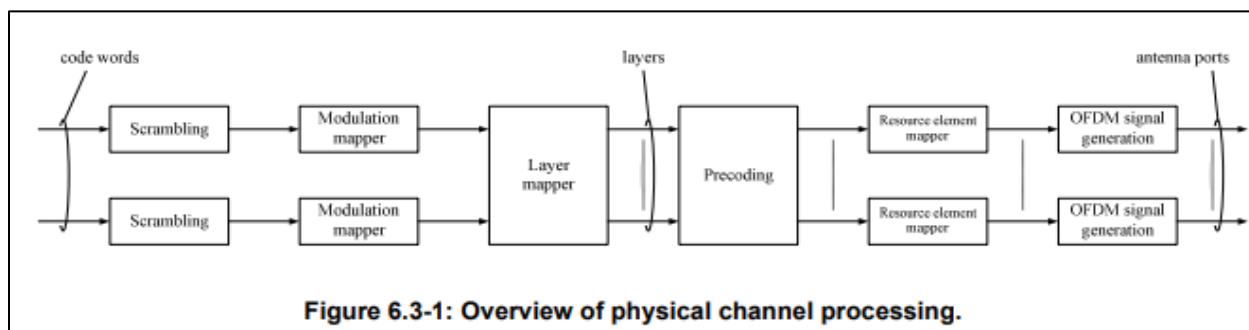
The sequence  $d(n)$  used for the primary synchronization signal is generated from a frequency-domain Zadoff-Chu sequence according to

$$d_u(n) = \begin{cases} e^{-j\frac{u(n+1)}{63}} & n = 0, 1, \dots, 30 \\ e^{-j\frac{u(n+1)(n+2)}{63}} & n = 31, 32, \dots, 61 \end{cases}$$

where the Zadoff-Chu root sequence index  $u$  is given by Table 6.11.1.1-1.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/08.06.00\\_60/ts\\_136211v080600p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.06.00_60/ts_136211v080600p.pdf))



(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/08.06.00\\_60/ts\\_136211v080600p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.06.00_60/ts_136211v080600p.pdf))

**Preamble and Pilot**

There are two different ways to transmit training symbols: preamble or pilot tones. Preambles entail sending a certain number of training symbols prior to the user data symbols. In the case of OFDM, one or two preamble OFDM symbols are typical. Pilot tones involve inserting a few known pilot symbols among the subcarriers. Channel estimation in MIMO-OFDM systems can be performed in a variety of ways, but it is typical to use the preamble for synchronization<sup>7</sup> and initial channel estimation, and the pilot tones for tracking the time-varying channel in order to maintain accurate channel estimates.

In MIMO-OFDM, the received signal at each antenna is a superposition of the signals transmitted from the  $N_t$  transmit antennas. Thus, the training signals for each transmit antenna need to be transmitted without interfering with each other in order to accurately estimate the channel. [Figure 5.18](#) shows three different patterns for MIMO-OFDM that avoid interfering with each other: independent, scattered, and orthogonal patterns [\[50\]](#).

(Source: Fundamentals of LTE, Ghosh et al.)

19. The methods practiced by Sonim's use of the accused products include transmitting the frame over a channel. The data frames having cyclic prefixes and other OFDM symbols are transmitted over a channel (e.g. PDCCH). Alternatively, on request from an accused product, an LTE base station can act as a transmitter and transmit the frame over a channel.

**4.2.1 Multiple Access**

The multiple access scheme for the LTE physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP) in the downlink, and on Single-Carrier Frequency Division Multiple Access (SC-FDMA) with a cyclic prefix in the uplink. To support transmission in paired and unpaired spectrum, two duplex modes

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf))



## 6.7 Physical control format indicator channel

The physical control format indicator channel carries information about the number of OFDM symbols used for transmission of PDCCHs in a subframe. The set of OFDM symbols possible to use for PDCCH in a subframe is given by Table 6.7-1.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/11.05.00\\_60/ts\\_136211v110500p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/11.05.00_60/ts_136211v110500p.pdf))


20. The methods practiced by Sonim's use of the accused products include receiving the transmitted frame. For example, the receiving antennas of the accused products can receive the transmitted frames for further processing.

Meet Sonim XP8

## Smart for work because it's built to last

Serving, protecting and providing for others demands a smart device you can rely on. Sonim XP8 is the ultra-reliable, ultra-rugged smartphone that's built to provide those who serve with the smart communication they need, regardless of situation or environment.

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The image is a promotional graphic for the Sonim XP8 smartphone. On the left, there is a light blue vertical panel containing text: 'Meet Sonim XP8', a large headline 'Smart for work because it's built to last', a descriptive paragraph about the phone's reliability, and a red button labeled 'Watch Video'. To the right of this panel is a photograph of the Sonim XP8 smartphone. The phone is black with a rugged, textured case and is shown lying on a dark, rusty metal surface. The screen is on, displaying a search bar at the top, a grid of app icons (Gmail, Photos, Maps, Play Store, Phone, Messages, Chrome, and Camera) in the middle, and a dock at the bottom. In the bottom right corner of the phone's frame, there is a red and white badge that reads '3 YEAR COMPREHENSIVE WARRANTY'. To the right of the phone, there are some mechanical parts, including a bolt and a nut, further emphasizing the rugged theme.

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

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MIMO antenna for LTE

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(Source : <https://www.sonimtech.com/products/devices/xp3/>)

21. The methods practiced by Sonim's use of the accused products include demodulating the received frame. For example, according to the LTE standards, the physical layer performs various functions which include modulation and demodulation of physical channels. Hence, the received frame will be demodulated for further processing.

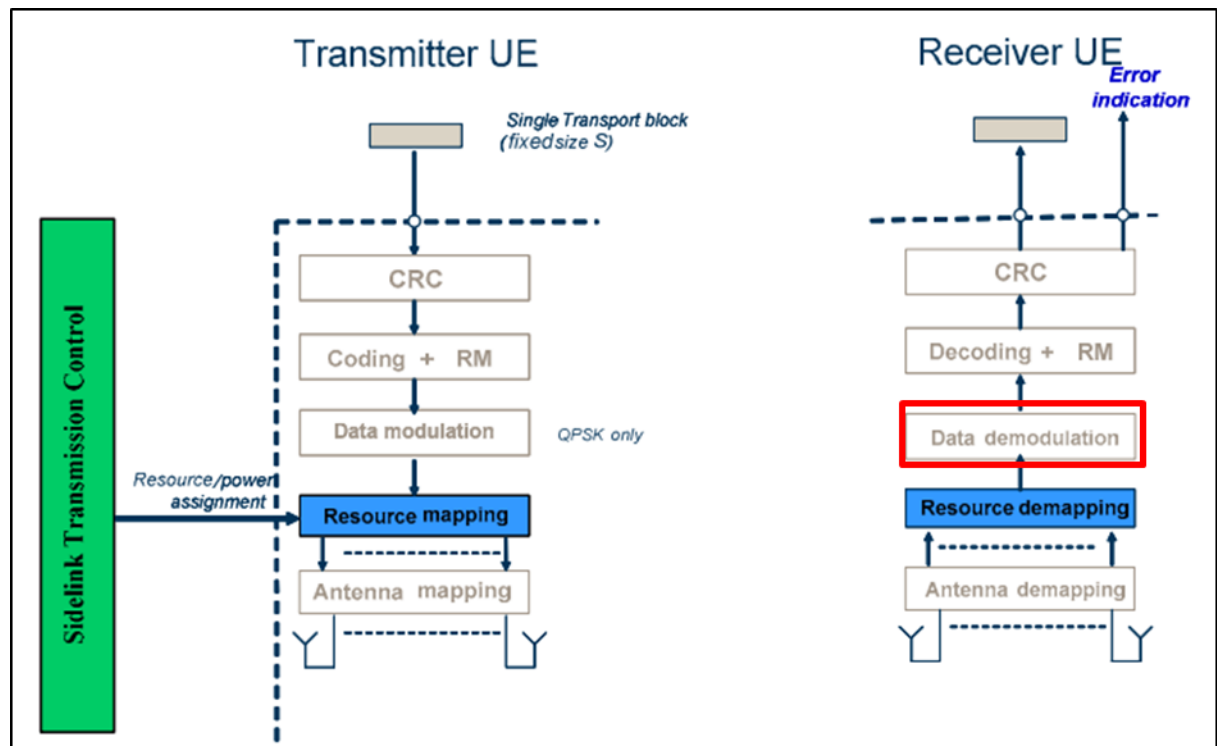
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- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation

(Source:

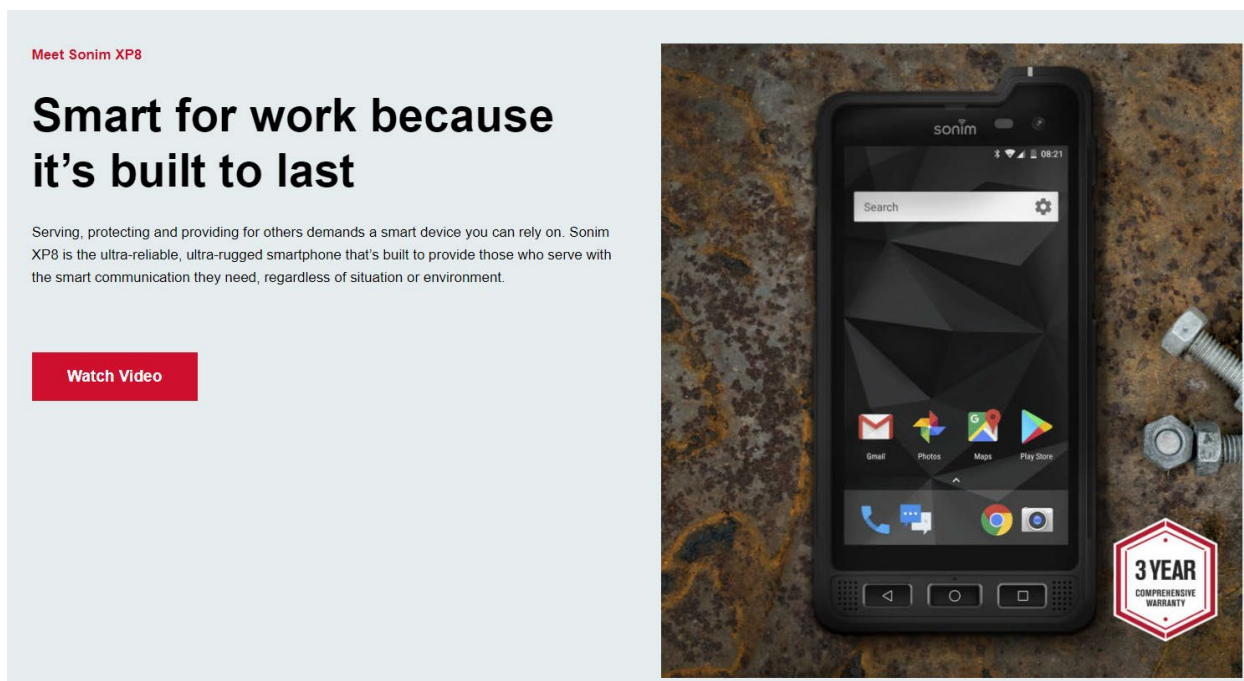
[https://www.etsi.org/deliver/etsi\\_ts/136300\\_136399/136302/15.00.00\\_60/ts\\_136302v150000p.pdf](https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/15.00.00_60/ts_136302v150000p.pdf))



(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136300\\_136399/136302/15.00.00\\_60/ts\\_136302v150000p.pdf](https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/15.00.00_60/ts_136302v150000p.pdf))

22. The methods practiced by Sonim's use of the accused products include synchronizing the received demodulated frame to the transmitted frame such that the data symbols are synchronized in the time domain and frequency domain. For example, according to the LTE standards, the physical layer performs various functions which include frequency and time synchronization. The procedure of achieving this time and frequency synchronizations is called 'Cell Search'.



(Source: <https://www.sonimtech.com/products/devices/xp8/>)

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### Antenna

MIMO antenna for LTE

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### Antenna

MIMO antenna for LTE

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## 5.2 Overview of L1 functions

The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

- Error detection on the transport channel and indication to higher layers
- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
- Radio characteristics measurements and indication to higher layers
- Multiple Input Multiple Output (MIMO) antenna processing

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136300\\_136399/136302/15.00.00\\_60/ts\\_136302v150000p.pdf](https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/15.00.00_60/ts_136302v150000p.pdf))

## 4.1 Cell search

Cell search is the procedure by which a UE acquires time and frequency synchronization with a cell and detects the physical layer Cell ID of that cell. E-UTRA cell search supports a scalable overall transmission bandwidth corresponding to 6 resource blocks and upwards.

The following signals are transmitted in the downlink to facilitate cell search: the primary and secondary synchronization signals.

A UE may assume the antenna ports 0 – 3 and the antenna port for the primary/secondary synchronization signals of a serving cell are quasi co-located (as defined in [3]) with respect to Doppler shift and average delay.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136213/14.02.00\\_60/ts\\_136213v140200p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/14.02.00_60/ts_136213v140200p.pdf))

23. The methods practiced by Sonim's use of the accused products include wherein the synchronizing in the time domain comprises coarse time synchronizing and fine time

synchronizing. For example, the physical layer performs time and frequency synchronization on received frames using the cell search procedure. It uses primary and secondary synchronization signals for time and frequency synchronization. The time synchronization includes coarse and fine time synchronizations. The PSS and the SSS are used for symbol timing and radio frame timing respectively providing coarse and fine timing synchronization.

The physical channels defined in the downlink are:

- the Physical Downlink Shared Channel (PDSCH),
- the Physical Multicast Channel (PMCH),
- the Physical Downlink Control Channel (PDCCH),
- the Relay Physical Downlink Control Channel (R-PDCCH),
- the Physical Broadcast Channel (PBCH),
- the Physical Control Format Indicator Channel (PCFICH)
- and the Physical Hybrid ARQ Indicator Channel (PHICH).

The physical channels defined in the uplink are:

- the Physical Random Access Channel (PRACH),
- the Physical Uplink Shared Channel (PUSCH),
- and the Physical Uplink Control Channel (PUCCH).

In addition, signals are defined as reference signals, primary and secondary synchronization signals.

The modulation schemes supported in the downlink and uplink are QPSK, 16QAM and 64QAM.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf))

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(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136213/14.02.00\\_60/ts\\_136213v140200p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/14.02.00_60/ts_136213v140200p.pdf))

In time- and frequency-synchronous multi-carrier transmission the receiver at the base station needs to detect the start position of an OFDM symbol or frame and to estimate the channel state information from some known pilot symbols inserted in each OFDM symbol. If the coherence time of the channel exceeds an OFDM symbol, the channel estimation can estimate the time variation as well. This strategy, which will be considered in the following, simplifies a burst receiver.

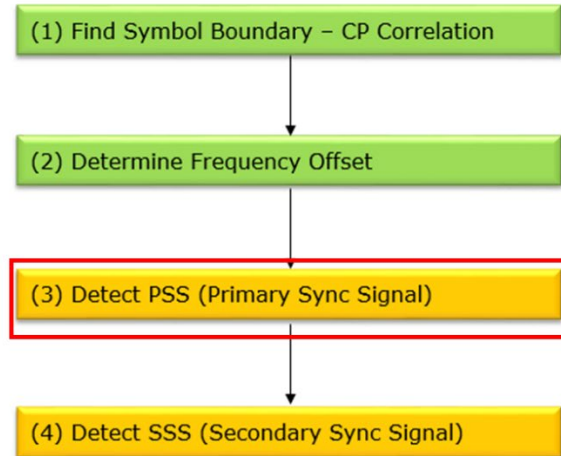
(Source: Multi-Carrier and Spread Spectrum Systems: From OFDM and MC-CDMA to LTE and WiMAX, Fazel et. Al (2008))

#### **4.2.4.2 Fine Symbol Timing**

For fine time synchronization, several methods based on transmitted reference symbols can be used [14]. One straightforward solution applies the estimation of the channel impulse response. The received signal without noise  $r(t) = s(t) \otimes h(t)$  is the convolution of the transmit signal  $s(t)$  and the channel impulse response  $h(t)$ . In the frequency domain after FFT processing we obtain  $R(f) = S(f)H(f)$ . By transmitting special reference symbols (e.g. CAZAC sequences [63]),  $S(f)$  is *a priori* known by the receiver. Hence,

(Source: Multi-Carrier and Spread Spectrum Systems: From OFDM and MC-CDMA to LTE and WiMAX, Fazel et. Al (2008))

If you go into a little bit further details, you would need a couple of additional steps as follows (step (1) and step (2)). To detect PSS and SSS, you need to get the data with a sequence of specific resource elements accurately. To accurately extract the data from a specific resource elements, you need to know the exact symbol boundary (starting sample and ending sample of an OFDM symbol). Once you detect the exact symbol boundary, you can detect the frequency offset (a kind of frequency error) to further compensate the signal. In some sense, these two steps are more difficult than PSS, SSS detection.



(Source: [http://www.sharetechnote.com/html/BasicProcedure\\_LTE\\_TimeSync.html](http://www.sharetechnote.com/html/BasicProcedure_LTE_TimeSync.html))

## Determining Frame Synchronization and Cell Identification

The cell search involves two steps:

1. Perform running correlation with three possible PSS and detect a peak in any of the three correlators. The position of the peak provides frame timing with an uncertainty of five subframes, as the PSS is present in both subframe 0 and subframe 5.
2. Once a peak is detected, perform correlation with 31 possible SSS in subframes 0 and 5 to find one of 168 possible combinations of two SSS.

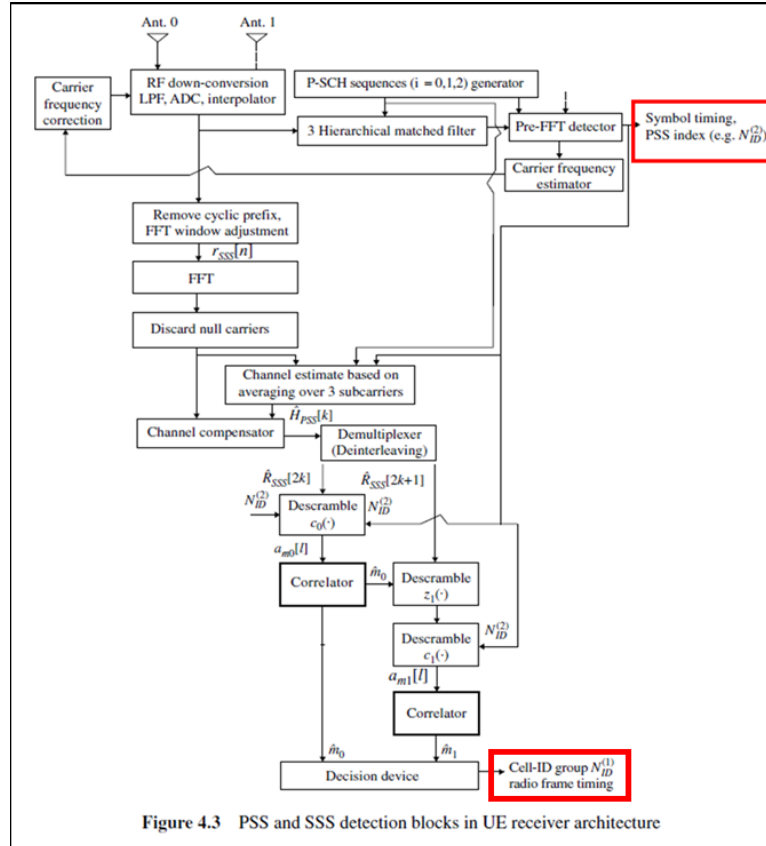
(Source: <https://www.mathworks.com/company/newsletters/articles/understanding-and-demodulating-lte-signals.html>)

### 15.1.1 DISCOVERY SIGNAL AND ASSOCIATED MEASUREMENTS

The *discovery reference signal* (DRS), although described as a new signal, actually consists of a combination already existing signals, namely

- synchronization signal (PSS and SSS) to assist in obtaining the cell identity and coarse frequency and time synchronization;
- cell-specific reference signals (CRS) to assist in obtaining fine frequency and time synchronization;
- CSI reference signals (optional) useful in determining the transmission point identity within the cell.

(Source: 4G, LTE-Advanced Pro and The Road to 5G, Dahlman et al. (2016))



(Source: Mobile Terminal Receiver Design: LTE and LTE-Advanced, Das, Sajal Kumar (2017))

#### Step1: Symbol Timing, Frequency Offset and Physical Layer ID Detection using PSS

In this stage, the symbol timing, frequency offset, and physical-layer ID are detected using PSS. As discussed above, the PSS occupies a bandwidth of  $62 \times 15$  kHz around the

(Source: Mobile Terminal Receiver Design: LTE and LTE-Advanced, Das, Sajal Kumar (2017))

#### Step-2: Radio Frame Timing and Cell Group ID Detection using SSS

Next, the radio-frame timing and cell group ID are detected using SSS in the frequency domain. As the SSS detection is generally performed in the frequency domain, FFT is



(Source: Mobile Terminal Receiver Design: LTE and LTE-Advanced, Das, Sajal Kumar (2017))

24. Sonim has had knowledge of the ‘782 Patent at least as of the date when it was notified of the filing of this action.

25. American Patents has been damaged as a result of the infringing conduct by Sonim alleged above. Thus, Sonim is liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

26. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the ‘782 Patent.

## **COUNT II**

### **DIRECT INFRINGEMENT OF U.S. PATENT NO. 7,310,304**

27. On December 18, 2007, United States Patent No. 7,310,304 (“the ‘304 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “Estimating Channel Parameters in Multi-Input, Multi-Output (MIMO) Systems.”

28. American Patents is the owner of the ‘304 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ‘304 Patent against infringers, and to collect damages for all relevant times.

29. Sonim made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Sonim XP8, Sonim XP7, Sonim XP5s, and Sonim XP3 families of products, that include LTE capabilities (“accused products”):

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### Antenna

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## Sonim XP7

The Sonim XP7 is the cornerstone of Sonim's Mission Critical Solution. An ultra-rugged, LTE/WiFi/Android smartphone, the XP7 is outfitted with unrivaled features such as a touch screen that can be viewed in direct sunlight and easily used with dirty or wet work gloves.

An extra loud speaker, noise cancellation, powerful battery, resistance to drops and water and a 3-Year comprehensive warranty are just some features of the XP7 that provide peace of mind to enterprises and workers alike.

Access to vertical enterprise worker safety and productivity applications as well as a full suite of industrial-grade accessories completes the solution. In extreme and often dangerous working environments where every step is critical, you don't settle for less than the best – Sonim XP7.

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(Source : <https://www.sonimtech.com/products/devices/xp3/>)

### Antenna

MIMO antenna for LTE

(Source : <https://www.sonimtech.com/products/devices/xp3/>)

30. By doing so, Sonim has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '304 Patent. Sonim's infringement in this regard is ongoing.

31. Sonim has infringed the '304 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale products including an Orthogonal Frequency Division Multiplexing (OFDM) transmitter. For example, the accused products support LTE standards with MIMO technology.

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Serving, protecting and providing for others demands a smart device you can rely on. Sonim XP8 is the ultra-reliable, ultra-rugged smartphone that's built to provide those who serve with the smart communication they need, regardless of situation or environment.

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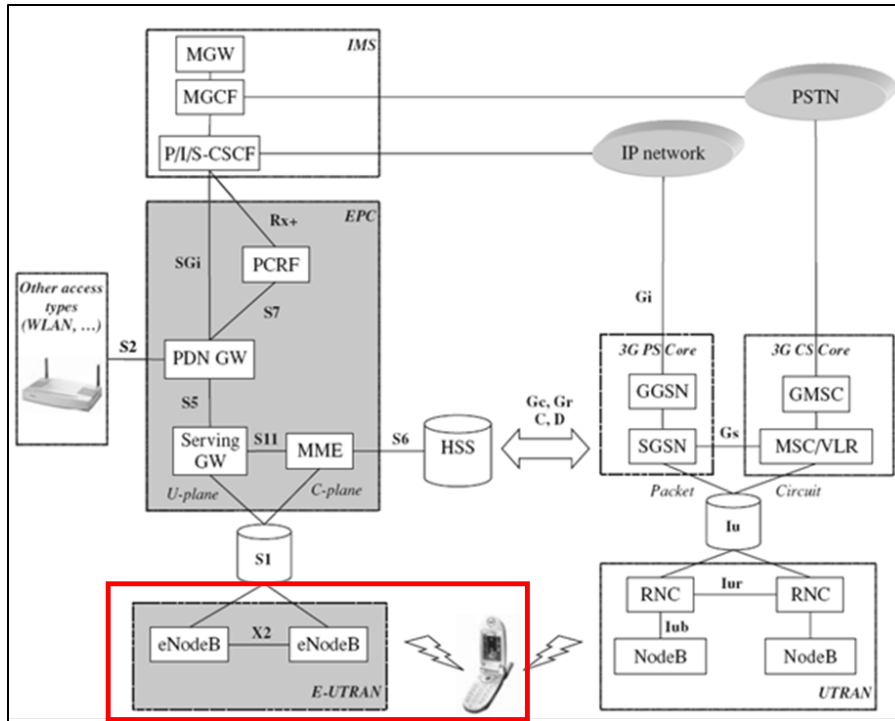
(Source : <https://www.sonimtech.com/products/devices/xp3/>)

### Antenna

MIMO antenna for LTE

(Source : <https://www.sonimtech.com/products/devices/xp3/>)





(Source: <https://sites.google.com/site/lteencyclopedia/lte-network-infrastructure-and-elements>)

32. The accused products include an encoder configured to process data to be transmitted within an OFDM system, the encoder further configured to separate the data onto one or more transmit diversity branches (TDBs). Alternatively, on request from an accused product, an LTE base station includes a transmitter in an OFDM system with an encoder configured to process data to be transmitted within an OFDM system, the encoder further configured to separate the data onto one or more transmit diversity branches (TDBs). For example, according to the LTE standards, the physical layer performs FEC encoding on the transmitting data. Hence, there is an encoder block at the transmitter end; additionally, transmit diversity is performed at the transmitter end. The encoders output the data onto multiple transmit chains (i.e. transmit diversity branches) for further processing.

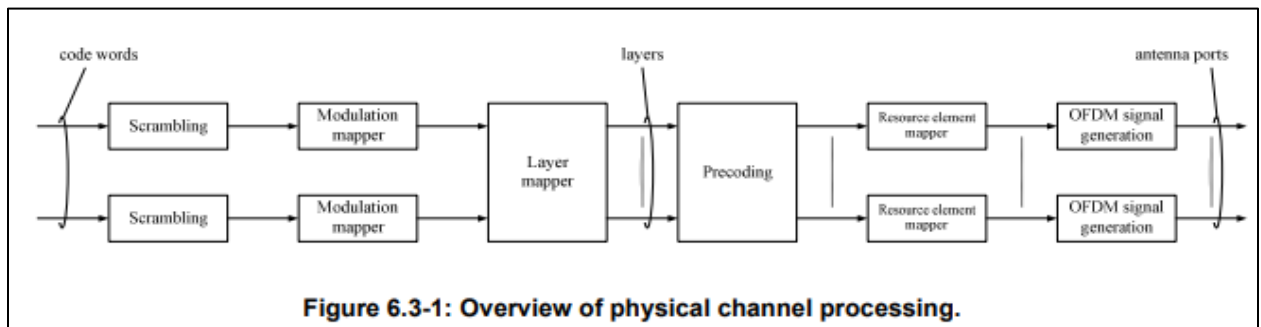
#### 4.1.2 Service provided to higher layers

The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

- Error detection on the transport channel and indication to higher layers
- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
- Radio characteristics measurements and indication to higher layers
- Multiple Input Multiple Output (MIMO) antenna processing
- Transmit Diversity (TX diversity)
- Beamforming
- RF processing. (Note: RF processing aspects are specified in the TS 36.100 series)

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf))



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[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/08.06.00\\_60/ts\\_136211v080600p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.06.00_60/ts_136211v080600p.pdf))

33. The accused products include one or more OFDM modulators, each OFDM modulator connected to a respective TDB, each OFDM modulator configured to produce a frame

including a plurality of data symbols, a training structure, and cyclic prefixes inserted among the data symbols. For example, the physical layer performs the modulation and demodulation of the physical channels. Further, it uses OFDM in the downlink physical channel. Hence, there would be OFDM modulators for modulating the data signals. The physical layer transmits frames of data on the downlink that include cyclic prefixes, training symbols and other data groups.

The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

- Error detection on the transport channel and indication to higher layers
- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
- Radio characteristics measurements and indication to higher layers

(Source:

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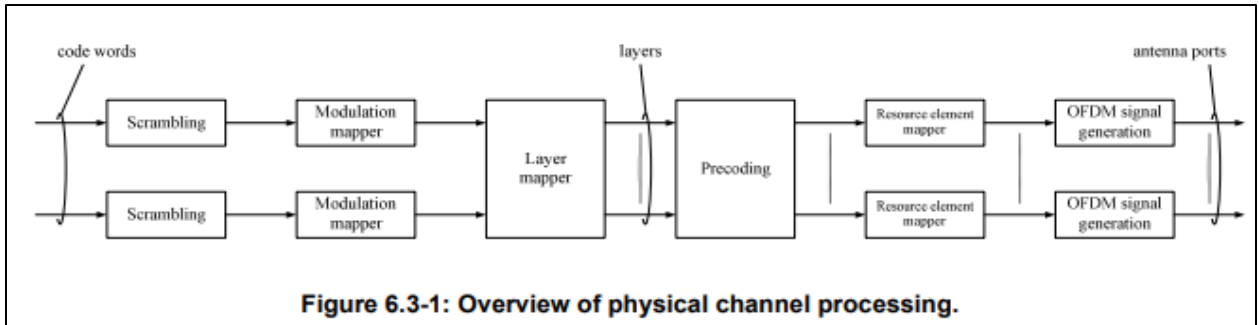
#### 4.2.1 Multiple Access

The multiple access scheme for the LTE physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP) in the downlink, and on Single-Carrier Frequency Division Multiple Access (SC-FDMA) with a cyclic prefix in the uplink. To support transmission in paired and unpaired spectrum, two duplex modes

(Source:

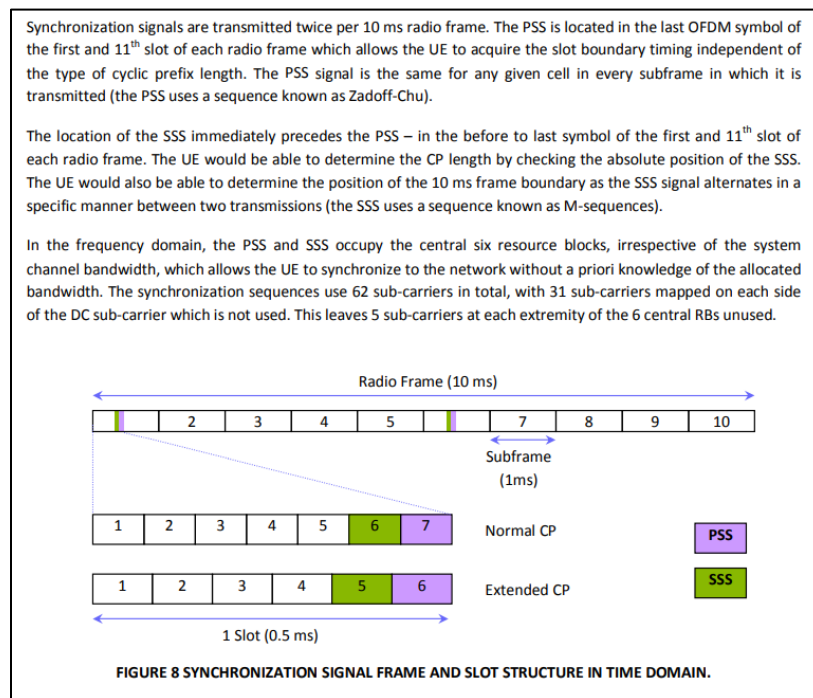
[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf))





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(Source: <https://home.zhaw.ch/kunr/NTM1/literatur/LTE%20in%20a%20Nutshell%20-%20Physical%20Layer.pdf>)

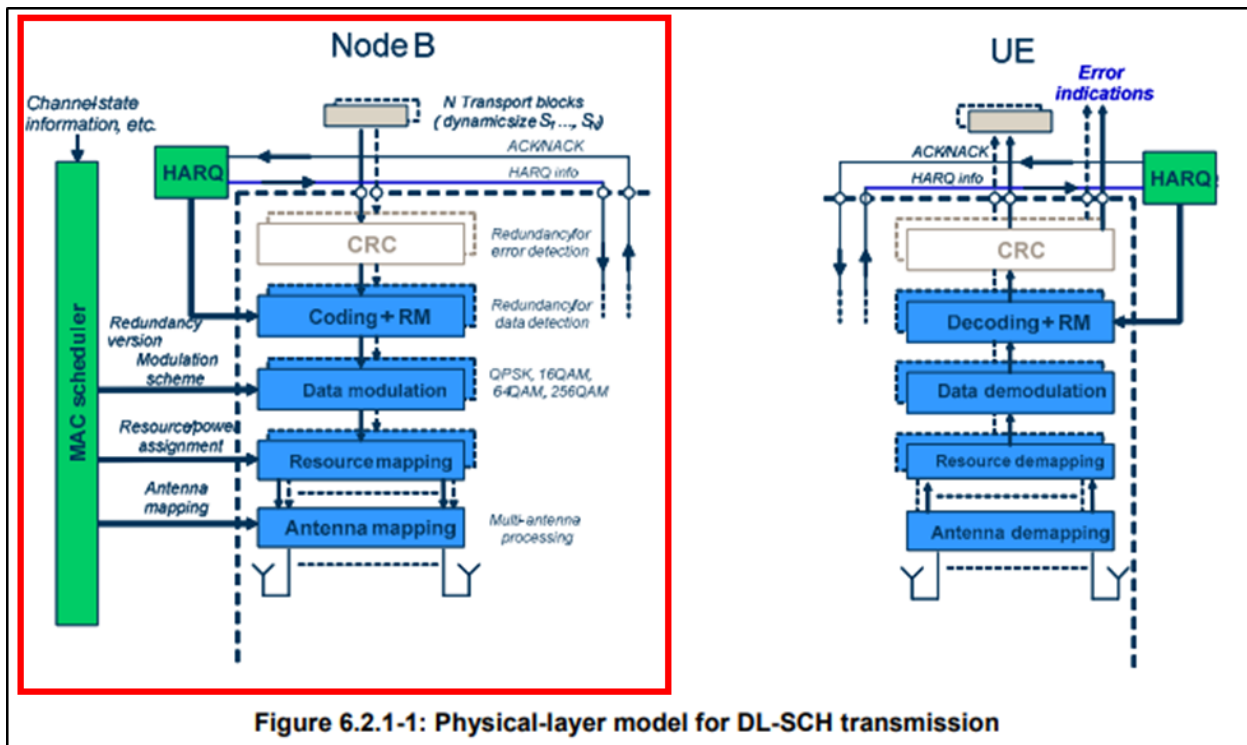
34. The accused products include one or more transmitting antennas in communication with the one or more OFDM modulators, respectively, each transmitting antenna configured to transmit the respective frame over a channel. Alternatively, on request from an accused product, an LTE base station includes one or more transmitting antennas in

communication with the one or more OFDM modulators, respectively, each transmitting antenna configured to transmit the respective frame over a channel. The transmitting antennas in the base station are connected to the OFDM modulators to get the OFDM frames for further transmission.

“Synchronization” refers to the technique applied to ensure the radios in the target LTE basestation are operating within the performance parameters defined by the appropriate 3rd Generation Partners Project (3GPP) standard. Synchronization is achieved by delivering a specifically formatted clock signal or signals to the basestation’s radio circuitry. These signals in turn are used to generate the modulation method’s RF air interface frequency/phase components.

The RF or air interface requirements of LTE are determined by the 3GPP, a collaboration between groups of telecommunications associations, known as the Organizational Partners. The 3GPP’s standardization encompasses radio, core network, and service architecture.

(Source: <https://www.electronicdesign.com/communications/lte-requires-synchronization-and-standards-support>)



(Source :

[https://www.etsi.org/deliver/etsi\\_ts/136300\\_136399/136302/15.00.00\\_60/ts\\_136302v150000p.p](https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/15.00.00_60/ts_136302v150000p.pdf)

[df](#))

## 6.7 Physical control format indicator channel

The physical control format indicator channel carries information about the number of OFDM symbols used for transmission of PDCCHs in a subframe. The set of OFDM symbols possible to use for PDCCH in a subframe is given by Table 6.7-1.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/11.05.00\\_60/ts\\_136211v110500p.p](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/11.05.00_60/ts_136211v110500p.pdf)

[df](#))

35. The accused products include wherein the training structure of each frame includes a predetermined signal transmission matrix at a respective sub-channel, each training structure adjusted to have a substantially constant amplitude in a time domain, and the cyclic prefixes are further inserted within the training symbol, and wherein the cyclic prefixes within the training symbol are longer than the cyclic prefixes among the data symbols, thereby countering an extended channel impulse response and improving synchronization performance. Alternatively, on request from an accused product, an LTE base station includes a transmitter in an Orthogonal Frequency Division Multiplexing (OFDM) system, the transmitter comprising one or more OFDM modulators configured to produce a frame including a plurality of data symbols, a training structure, and cyclic prefixes inserted among the data symbols; wherein the training structure of each frame includes a predetermined signal transmission matrix at a respective sub-channel, each training structure adjusted to have a substantially constant amplitude in a time domain, and the cyclic prefixes are further inserted within the training symbol, and wherein the cyclic prefixes within the training symbol are longer than the cyclic prefixes among the data

symbols, thereby countering an extended channel impulse response and improving synchronization performance. For example, the physical layer performs precoding on both the downlink by generating a precoding matrix (i.e. signal transmission matrix) which is transmitted along with the data frames. Cyclic prefixes are added to the transmitting frames to help in frame synchronization at the receiver end. The evidence shows that a cell-specific reference signal acting as the training sequence are used for channel estimation and are present in the first symbol of the slots in the frame. Also, the evidence shows that the cyclic prefix in the first symbol is longer than the cyclic prefix in the other data symbols. Thus, the cyclic prefix in the training structure reference signals are longer than the cyclic prefixes in the other data symbols. The primary synchronization signals and the cell specific reference signals are generated using Zadoff-Chu sequences which have a constant amplitude.

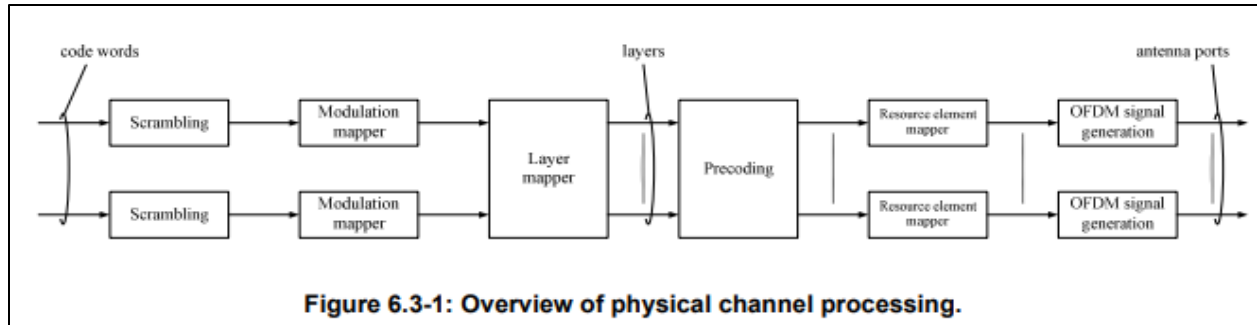
The scope of this specification is to establish the characteristics of the Layer-1 physical channels, generation of physical layer signals and modulation, and to specify:

- Definition of the uplink and downlink physical channels;
- The structure of the physical channels, frame format, physical resource elements, etc.;
- Modulation mapping (BPSK, QPSK, etc);
- Physical shared channel in uplink and downlink;
- Reference signal in uplink and downlink;
- Random access channel;
- Primary and secondary synchronization signals;
- OFDM signal generation in downlink;
- SC-FDMA signal generation in uplink;
- Scrambling, modulation and up conversion;
- Uplink-downlink timing relation;
- Layer mapping and precoding in downlink and uplink.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.p](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf)

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df)

### 6.3.4 Precoding

The precoder takes as input a block of vectors  $x(i) = [x^{(0)}(i) \dots x^{(v-1)}(i)]^T$ ,  $i = 0, 1, \dots, M_{\text{synt}}^{\text{layer}} - 1$  from the layer mapping and generates a block of vectors  $y(i) = [\dots y^{(p)}(i) \dots]^T$ ,  $i = 0, 1, \dots, M_{\text{synt}}^{\text{ap}} - 1$  to be mapped onto resources on each of the antenna ports, where  $y^{(p)}(i)$  represents the signal for antenna port  $p$ .

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/08.06.00\\_60/ts\\_136211v080600p.p](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.06.00_60/ts_136211v080600p.p)  
df)

#### 6.3.4.2.1 Precoding without CDD

Without cyclic delay diversity (CDD), precoding for spatial multiplexing is defined by

$$\begin{bmatrix} y^{(0)}(i) \\ \vdots \\ y^{(P-1)}(i) \end{bmatrix} = W(i) \begin{bmatrix} x^{(0)}(i) \\ \vdots \\ x^{(v-1)}(i) \end{bmatrix}$$

where the precoding matrix  $W(i)$  is of size  $P \times v$  and  $i = 0, 1, \dots, M_{\text{synt}}^{\text{ap}} - 1$ ,  $M_{\text{synt}}^{\text{ap}} = M_{\text{synt}}^{\text{layer}}$ .

For spatial multiplexing, the values of  $W(i)$  shall be selected among the precoder elements in the codebook configured in the eNodeB and the UE. The eNodeB can further confine the precoder selection in the UE to a subset of the elements in the codebook using codebook subset restrictions. The configured codebook shall be selected from Table 6.3.4.2.3-1 or 6.3.4.2.3-2.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/08.06.00\\_60/ts\\_136211v080600p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.06.00_60/ts_136211v080600p.pdf))

#### 6.3.4.2.2 Precoding for large delay CDD

For large-delay CDD, precoding for spatial multiplexing is defined by

$$\begin{bmatrix} y^{(0)}(i) \\ \vdots \\ y^{(P-1)}(i) \end{bmatrix} = W(i)D(i)U \begin{bmatrix} x^{(0)}(i) \\ \vdots \\ x^{(v-1)}(i) \end{bmatrix}$$

where the precoding matrix  $W(i)$  is of size  $P \times v$  and  $i = 0, 1, \dots, M_{\text{sym}}^{\text{ap}} - 1$ ,  $M_{\text{sym}}^{\text{ap}} = M_{\text{sym}}^{\text{layer}}$ . The diagonal size- $v \times v$  matrix  $D(i)$  supporting cyclic delay diversity and the size- $v \times v$  matrix  $U$  are both given by Table 6.3.4.2.2-1 for different numbers of layers  $v$ .

The values of the precoding matrix  $W(i)$  shall be selected among the precoder elements in the codebook configured in the eNodeB and the UE. The eNodeB can further confine the precoder selection in the UE to a subset of the elements in the codebook using codebook subset restriction. The configured codebook shall be selected from Table 6.3.4.2.3-1 or 6.3.4.2.3-2.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/08.06.00\\_60/ts\\_136211v080600p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.06.00_60/ts_136211v080600p.pdf))

The spatial correlation matrix for the complete system can be calculated using equation (1) above and forming the individual spatial correlation matrices at the eNB and the UE. For example, given a 2x2 MIMO system, assume the factors  $\alpha$  and  $\beta$  represent the correlation coefficients, calculated using (1), for the eNB and UE antenna pairs, respectively. The correlation matrices for eNB and the UE are represented as

$$R_{\text{BS}} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}, \quad (2)$$

$$R_{\text{MS}} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}. \quad (3)$$

The system spatial correlation matrix for the downlink channel can be calculated using the Kronecker product

$$R_{\text{S}} = R_{\text{BS}} \otimes R_{\text{MS}}, \quad (4)$$

$$R_{\text{S}} = \begin{pmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{pmatrix}. \quad (5)$$

These expressions are needed to determine the parameters for the user interface of a fading emulator.

(Source: LTE and the Evolution to 4G Wireless: Design and Measurement Challenges, Wiley (2013))

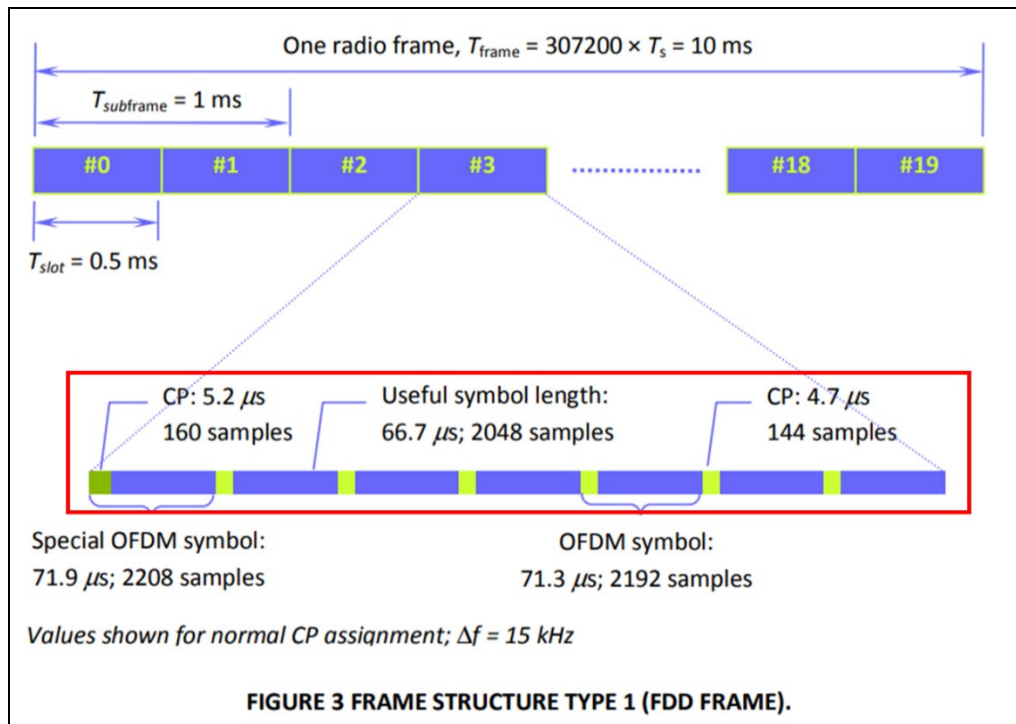


The useful symbol time is  $T_u = 2048 \cdot T_s \approx 66.7 \mu\text{s}$ . For the normal mode, the first symbol has a cyclic prefix of length  $T_{CP} = 160 \cdot T_s \approx 5.2 \mu\text{s}$ . The remaining six symbols have a cyclic prefix of length  $T_{CP} = 144 \cdot T_s \approx 4.7 \mu\text{s}$ . The reason for different CP length of the first symbol is to make the overall slot length in terms of time units divisible by 15360. For the extended mode, the cyclic prefix is  $T_{CP-e} = 512 \cdot T_s \approx 16.7 \mu\text{s}$ . The CP is longer than the typical delay spread of a few microseconds typically encountered in practice as shown in Figure 4. The normal cyclic prefix is used in urban cells and high data rate applications while the extended cyclic prefix is used in special cases like multi-cell broadcast and in very large cells (e.g. rural areas, low data rate applications).

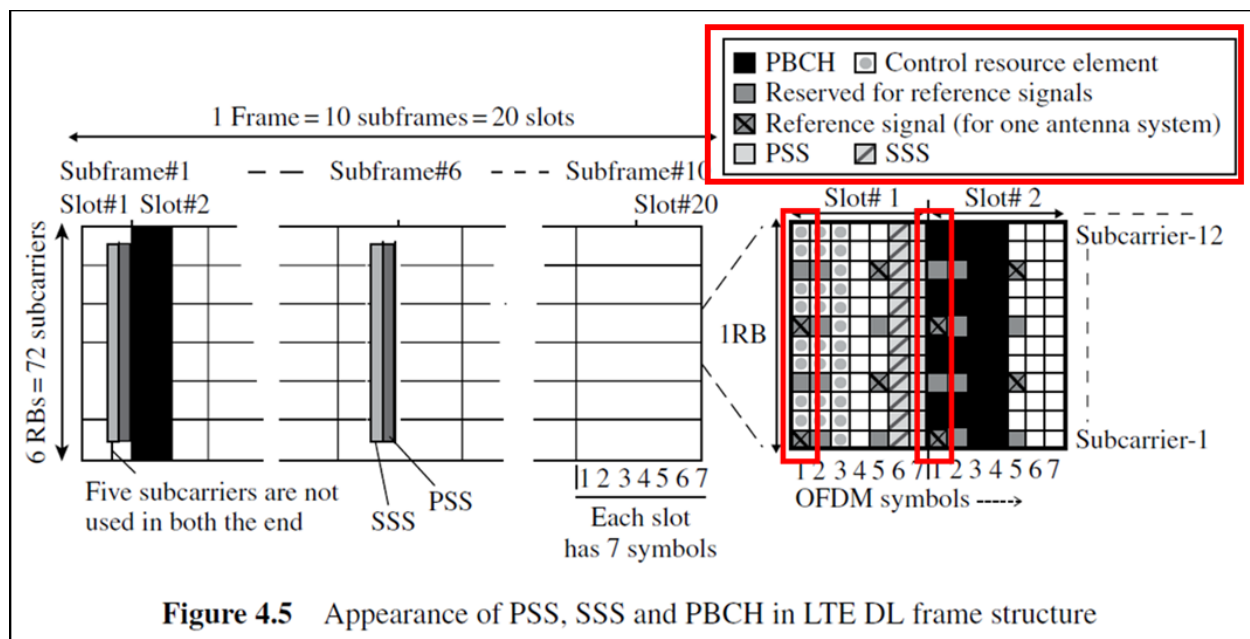
(Source: <https://home.zhaw.ch/kunr/NTM1/literatur/LTE%20in%20a%20Nutshell%20-%20Physical%20Layer.pdf>)

According to Chapter 4, a subcarrier spacing  $\Delta f = 15 \text{ kHz}$  corresponds to a useful symbol time  $T_u = 1/\Delta f \approx 66.7 \mu\text{s}$  ( $2048 \cdot T_s$ ). The overall OFDM symbol time is then the sum of the useful symbol time and the cyclic-prefix length  $T_{CP}$ . As illustrated in Figure 16.5, LTE defines two cyclic-prefix lengths, the normal cyclic prefix and an *extended* cyclic prefix, corresponding to seven and six OFDM symbols per slot, respectively. The exact cyclic-prefix lengths, expressed in the basic time unit  $T_s$ , are given in Figure 16.5. It should be noted that, in case of the normal cyclic prefix, the cyclic-prefix length for the first OFDM symbol of a slot is somewhat larger, compared to the remaining OFDM symbols. The reason for this is simply to fill the entire 0.5 ms slot as the number of time units  $T_s$  per slot (15360) is not dividable by seven.

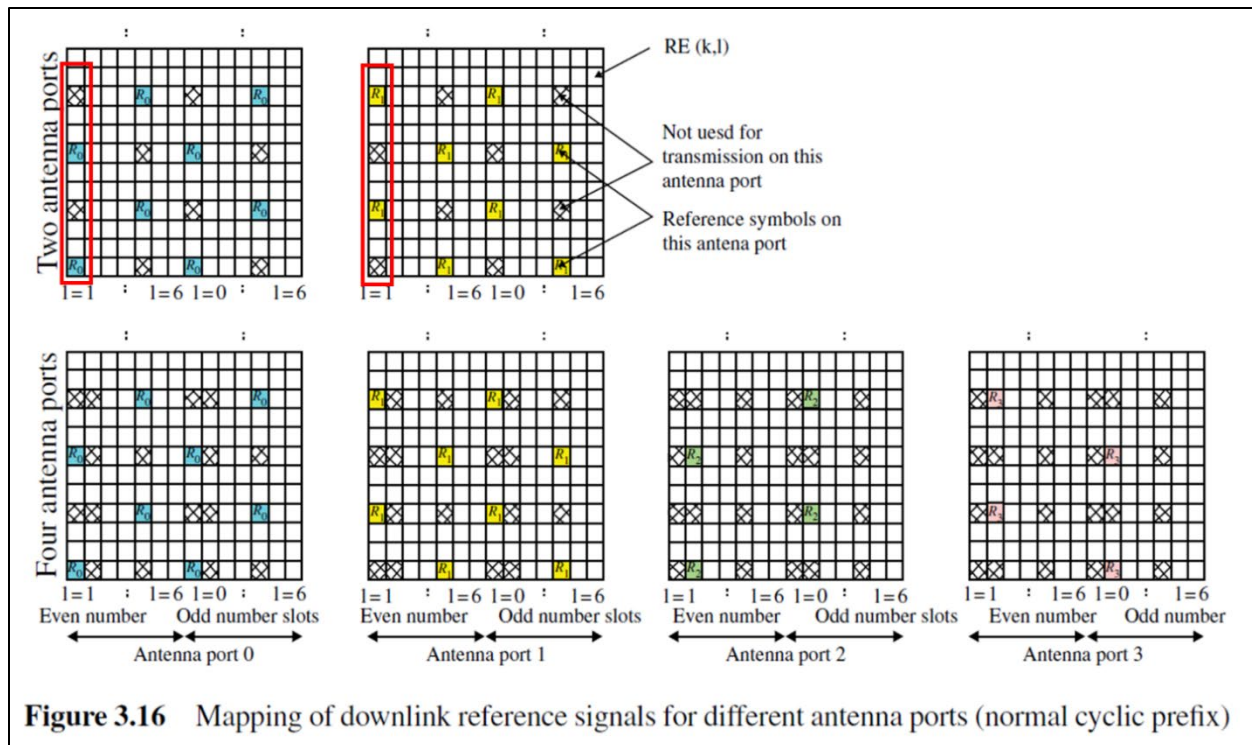
(Source: 3G Evolution: HSPA and LTE for Mobile Broadband, Dahlman, et al. (2010))



(Source: <https://home.zhaw.ch/kunr/NTM1/literatur/LTE%20in%20a%20Nutshell%20-%20Physical%20Layer.pdf>)



(Source: Mobile Terminal Receiver Design: LTE and LTE-Advanced, Das, Sajal Kumar (2017))



**Figure 3.16** Mapping of downlink reference signals for different antenna ports (normal cyclic prefix)

(Source: Mobile Terminal Receiver Design: LTE and LTE-Advanced, Das, Sajal Kumar (2017))

### 6.11.1 Primary synchronization signal

#### 6.11.1.1 Sequence generation

The sequence  $d(n)$  used for the primary synchronization signal is generated from a frequency-domain Zadoff-Chu sequence according to

$$d_u(n) = \begin{cases} e^{-j\frac{u(n+1)}{63}} & n = 0, 1, \dots, 30 \\ e^{-j\frac{u(n+1)(n+2)}{63}} & n = 31, 32, \dots, 61 \end{cases}$$

where the Zadoff-Chu root sequence index  $u$  is given by Table 6.11.1.1-1.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136211/08.06.00\\_60/ts\\_136211v080600p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.06.00_60/ts_136211v080600p.pdf))

### **Zadoff chu sequence properties:**

- It has constant amplitude.
- It has zero circular auto correlation.
- It has flat frequency domain response.
- circular cross correlation between two zadoff chu sequence is low.
- It has constant amplitude provided, L is a prime number.

### **LTE physical signals/channels where Zadoff chu is used**

**P-SS:** Primary synchronization signal, Zadoff chu sequence is used for this signal.

**RS:** Reference Signal, used both in uplink and downlink, Zadoff chu sequence is used.

**PUCCH:** Physical Uplink Control Channel, Zadoff chu sequence is used.

(Source: <http://www.rfwireless-world.com/Terminology/Zadoff-chu-sequence-LTE.html>)

36. Sonim has had knowledge of the '304 Patent at least as of the date when it was notified of the filing of this action.

37. American Patents has been damaged as a result of the infringing conduct by Sonim alleged above. Thus, Sonim is liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

38. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '304 Patent.

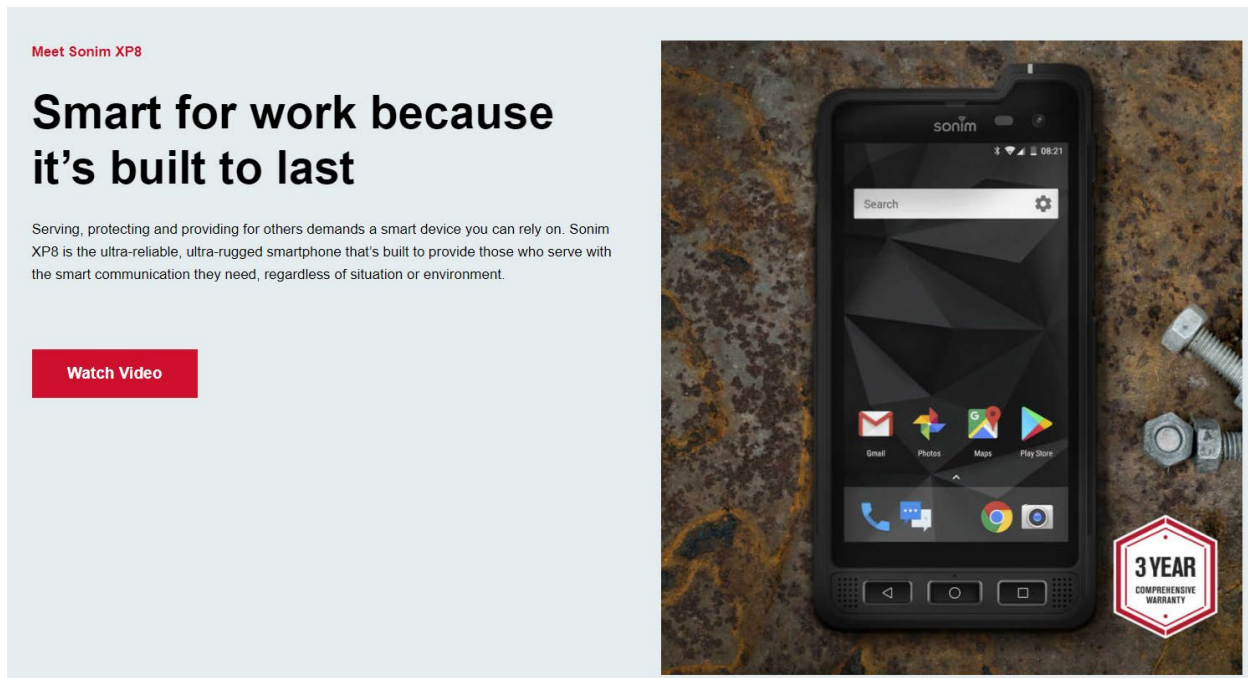
### **COUNT III**

#### **DIRECT INFRINGEMENT OF U.S. PATENT NO. 7,706,458**

39. On April 27, 2010, United States Patent No. 7,706,458 (“the ‘458 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “Time And Frequency Synchronization In Multi-Input, Multi-Output (MIMO) Systems.”

40. American Patents is the owner of the ‘458 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ‘458 Patent against infringers, and to collect damages for all relevant times.

41. Sonim made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Sonim XP8, Sonim XP7, Sonim XP5s, and Sonim XP3 families of products, that include LTE capabilities (“accused products”):



(Source: <https://www.sonimtech.com/products/devices/xp8/>)

## Antenna

MIMO antenna for LTE

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

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An extra loud speaker, noise cancellation, powerful battery, resistance to drops and water and a 3-Year comprehensive warranty are just some features of the XP7 that provide peace of mind to enterprises and workers alike.

Access to vertical enterprise worker safety and productivity applications as well as a full suite of industrial-grade accessories completes the solution. In extreme and often dangerous working environments where every step is critical, you don't settle for less than the best – Sonim XP7.

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(Source : <https://www.sonimtech.com/products/devices/xp3/>)

42. By doing so, Sonim has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the ‘458 Patent. Sonim’s infringement in this regard is ongoing.

43. Sonim has infringed the ‘458 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale products including an apparatus for synchronizing a communication system. The accused product is a receiver in an apparatus for synchronizing a communication system. An LTE compliant base station that is communicating with an accused product can be part of the apparatus, acting as a transmitter. For example, according to the LTE standards, the physical layer performs various functions which include


modulation and demodulation of physical channels, as well as time and frequency synchronization.

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## Smart for work because it's built to last

Serving, protecting and providing for others demands a smart device you can rely on. Sonim XP8 is the ultra-reliable, ultra-rugged smartphone that's built to provide those who serve with the smart communication they need, regardless of situation or environment.

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A black Sonim XP8 smartphone is shown lying on a heavily rusted, metallic surface. The phone's screen is on, displaying a search bar at the top, a grid of app icons (Gmail, Photos, Maps, Play Store, Phone, Messages, Chrome, Camera) below, and a dock at the bottom. To the right of the phone, there are several metal bolts and nuts. In the bottom right corner of the image, there is a red and white badge that reads "3 YEAR COMPREHENSIVE WARRANTY".

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

### Antenna

MIMO antenna for LTE

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

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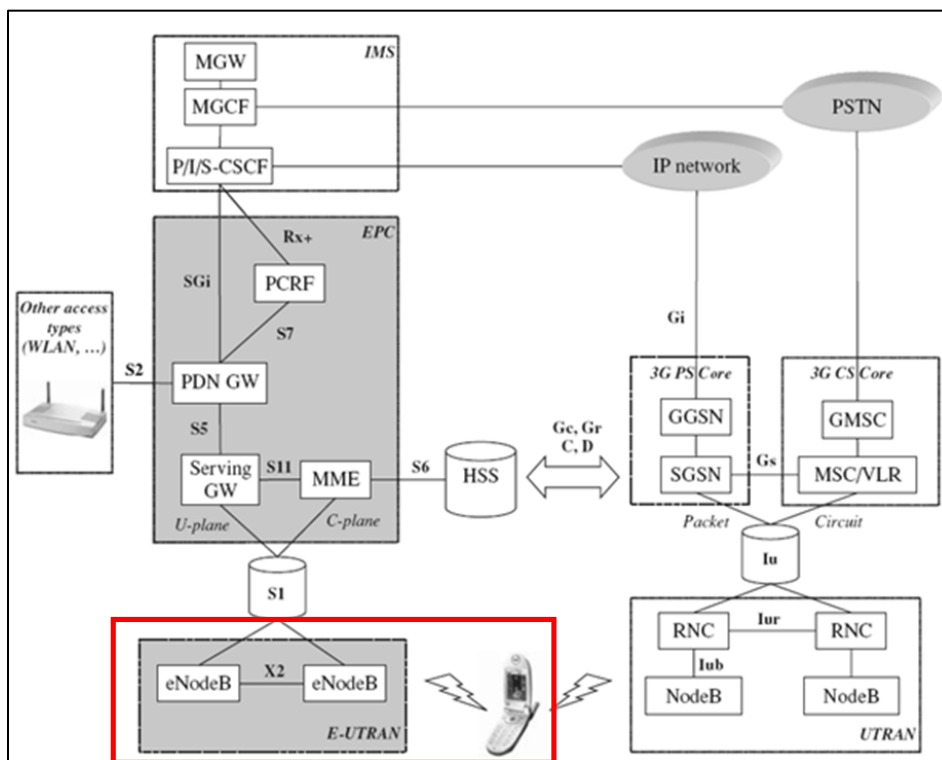
(Source : <https://www.sonimtech.com/products/devices/xp3/>)



“Synchronization” refers to the technique applied to ensure the radios in the target LTE basestation are operating within the performance parameters defined by the appropriate 3rd Generation Partners Project (3GPP) standard. Synchronization is achieved by delivering a specifically formatted clock signal or signals to the basestation’s radio circuitry. These signals in turn are used to generate the modulation method’s RF air interface frequency/phase components.

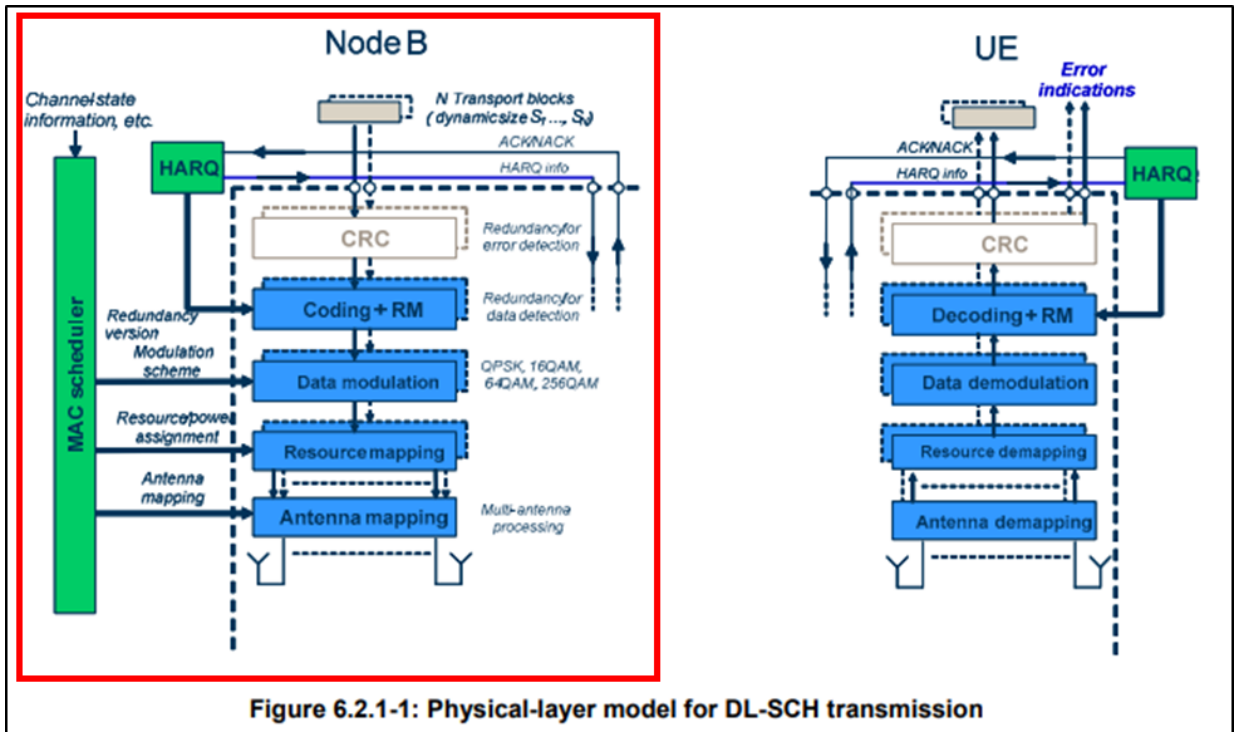
The RF or air interface requirements of LTE are determined by the 3GPP, a collaboration between groups of telecommunications associations, known as the Organizational Partners. The 3GPP’s standardization encompasses radio, core network, and service architecture.

(Source: <https://www.electronicdesign.com/communications/lte-requires-synchronization-and-standards-support>)



(Source: <https://sites.google.com/site/lteencyclopedia/lte-network-infrastructure-and-elements>)





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The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

- Error detection on the transport channel and indication to higher layers
- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
- Radio characteristics measurements and indication to higher layers
- Multiple Input Multiple Output (MIMO) antenna processing

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44. The accused products include a number (Q) of Orthogonal Frequency Division Multiplexing (OFDM) modulators, each OFDM modulator producing a frame having at least one inserted symbol, a plurality of data symbols, and cyclic prefixes. Alternatively, on being requested by an accused product, an LTE base station acts as a transmitter and includes a number (Q) of Orthogonal Frequency Division Multiplexing (OFDM) modulators, each OFDM modulator producing a frame having at least one inserted symbol, a plurality of data symbols, and cyclic prefixes. The LTE base station eNodeB acts as the transmitter for the OFDM frames. The physical layer performs the modulation and demodulation of the physical channels. Further, it uses OFDM in the downlink physical channel. Hence, there would be OFDM modulators for modulating the data signals at the base station. The physical layer transmits frames of data on the downlink, that includes data symbols, synchronization symbols such as PSS, SSS and cyclic prefixes.

The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

- Error detection on the transport channel and indication to higher layers
- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
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(Source:

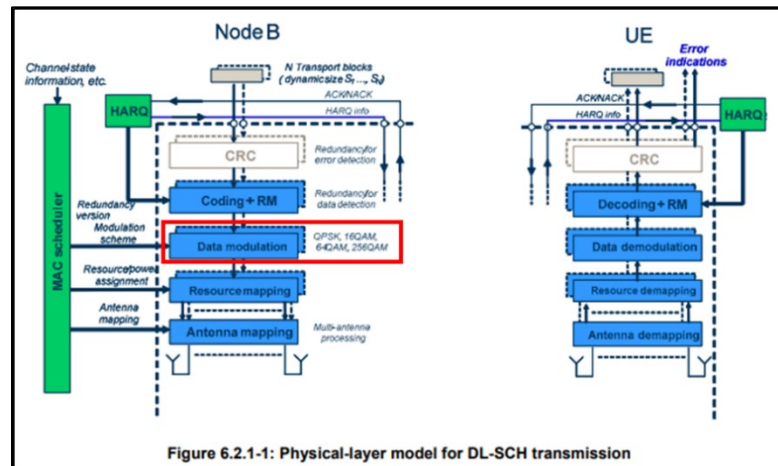
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#### 4.2.1 Multiple Access

The multiple access scheme for the LTE physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP) in the downlink, and on Single-Carrier Frequency Division Multiple Access (SC-FDMA) with a cyclic prefix in the uplink. To support transmission in paired and unpaired spectrum, two duplex modes

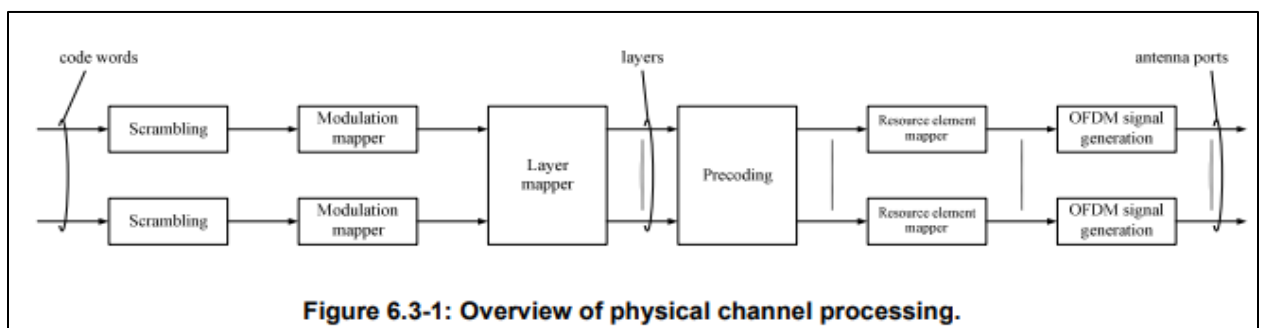
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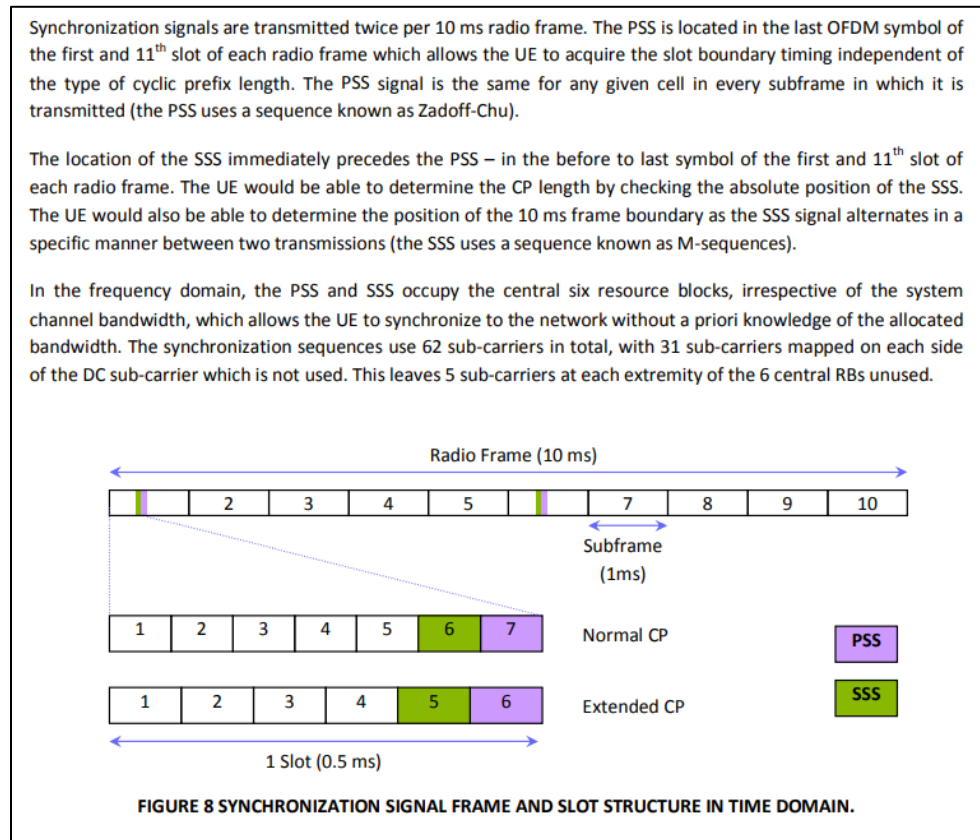
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(Source: <https://home.zhaw.ch/kunr/NTM1/literatur/LTE%20in%20a%20Nutshell%20-%20Physical%20Layer.pdf>)

45. The accused products include Q transmitting antennas, each transmitting antenna connected to a respective OFDM modulator, the transmitting antennas configured to transmit a respective frame over a channel. Alternatively, on being requested by an accused product, the LTE base station can act as a transmitter and include Q transmitting antennas, each transmitting antenna connected to a respective OFDM modulator, the transmitting antennas configured to transmit a respective frame over a channel. The LTE base station eNodeB acts as the transmitter for the data frames. The data frames having cyclic prefixes and other OFDM symbols are

transmitted over a channel (PDCCH, etc.). The transmitting antennas of a base station would transmit multiple OFDM frames over a channel. Thus, these transmitting antennas would be connected to OFDM modulators to get the OFDM frames for further transmission.

## 6.7 Physical control format indicator channel

The physical control format indicator channel carries information about the number of OFDM symbols used for transmission of PDCCHs in a subframe. The set of OFDM symbols possible to use for PDCCH in a subframe is given by Table 6.7-1.

(Source:

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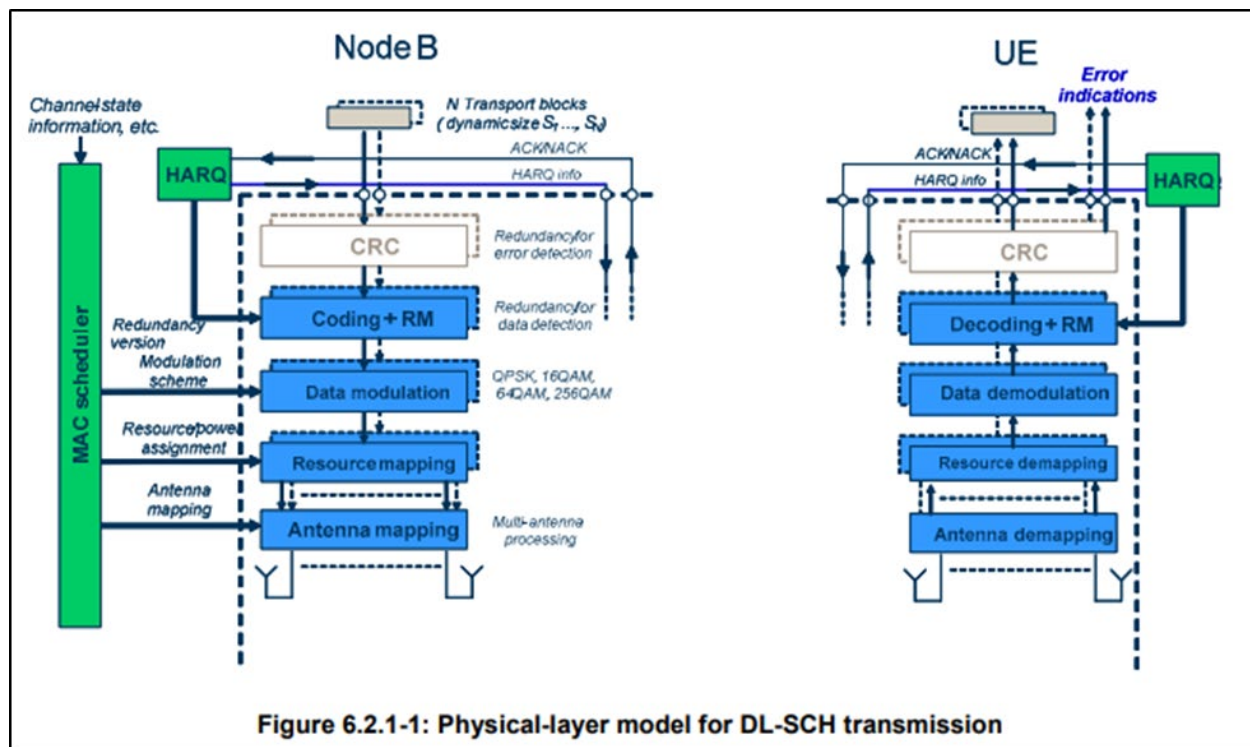


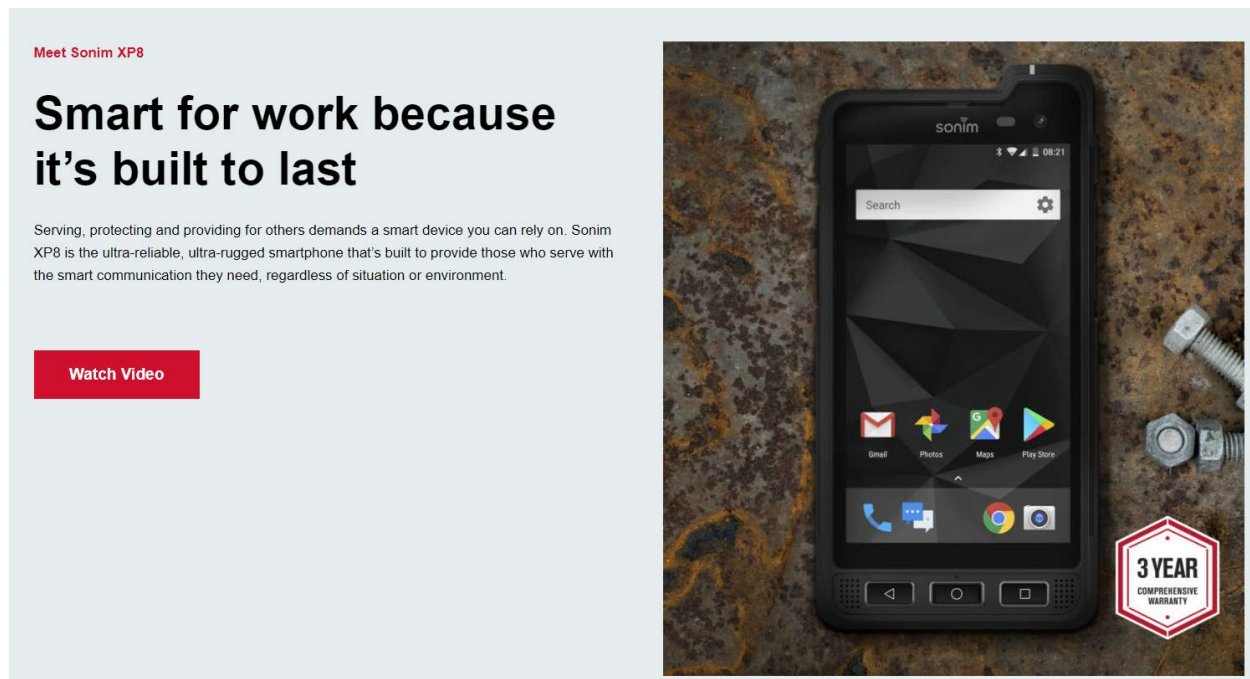
Figure 6.2.1-1: Physical-layer model for DL-SCH transmission

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46. The accused products include a number (L) of receiving antennas for receiving the transmitted frames. For example, the accused products comply with LTE standards and uses MIMO antenna system. These receiving antennas would receive the frames transmitted by the base station.



(Source: <https://www.sonimtech.com/products/devices/xp8/>)

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(Source: <https://www.sonimtech.com/products/devices/xp8/>)



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47. The accused products include L OFDM demodulators, each OFDM demodulator corresponding to a respective receiving antenna, the L OFDM demodulators including a synchronization circuit that processes the received frame in order to synchronize the received

frame in both time domain and frequency domain. For example, according to the LTE standards, the physical layer performs various functions which include modulation and demodulation, as well as frequency and time synchronization. Hence, there would be demodulator blocks and synchronization circuits for performing these functions. The procedure of achieving time and frequency synchronizations is called 'Cell Search'.

The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

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- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
- Radio characteristics measurements and indication to higher layers

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf))

## 4.1 Cell search

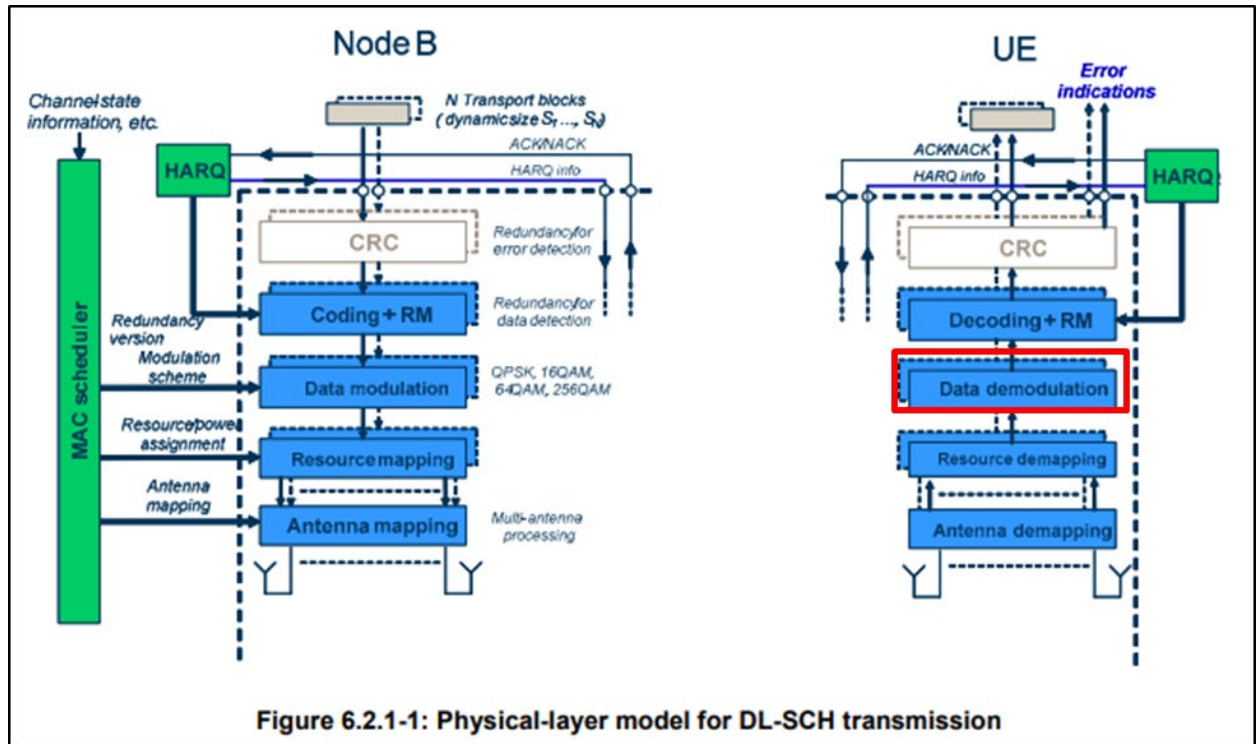
Cell search is the procedure by which a UE acquires time and frequency synchronization with a cell and detects the physical layer Cell ID of that cell. E-UTRA cell search supports a scalable overall transmission bandwidth corresponding to 6 resource blocks and upwards.

The following signals are transmitted in the downlink to facilitate cell search: the primary and secondary synchronization signals.

A UE may assume the antenna ports 0 – 3 and the antenna port for the primary/secondary synchronization signals of a serving cell are quasi co-located (as defined in [3]) with respect to Doppler shift and average delay.

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136213/14.02.00\\_60/ts\\_136213v140200p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/14.02.00_60/ts_136213v140200p.pdf))



(Source:

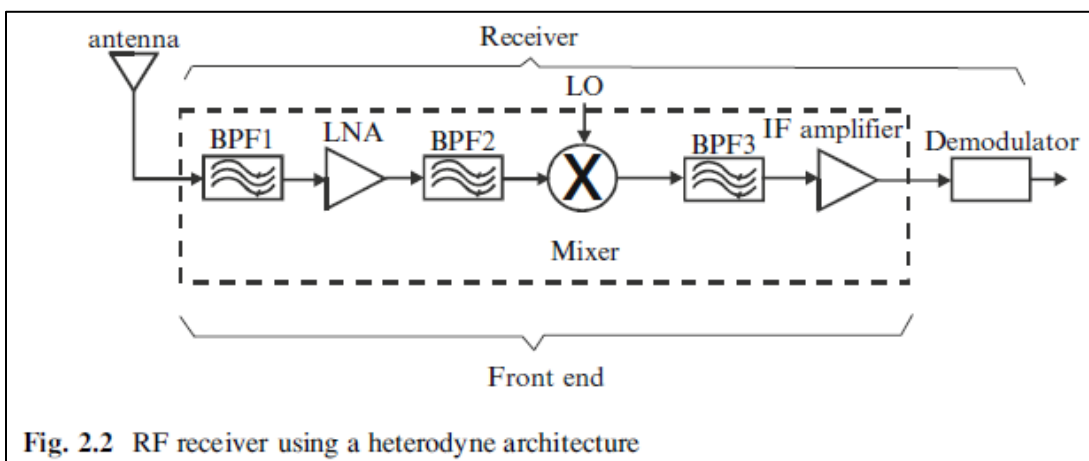
[https://www.etsi.org/deliver/etsi\\_ts/136300\\_136399/136302/15.00.00\\_60/ts\\_136302v15000p.pdf](https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/15.00.00_60/ts_136302v15000p.pdf))

48. The accused products include wherein each of the L OFDM demodulators comprises a pre-amplifier, a local oscillator, a mixer having a first input and a second input, the first input connected to an output of the pre-amplifier, the second input connected to an output of the local oscillator, an analog-to-digital converter (ADC) connected to an output of the mixer. LTE devices generally include RF Front-end Modules. After the data is transmitted by the base station, the data is received by a receiving antenna of the accused product for further processing. To prevent the demodulator from demodulating the noise associated with the received signal, an

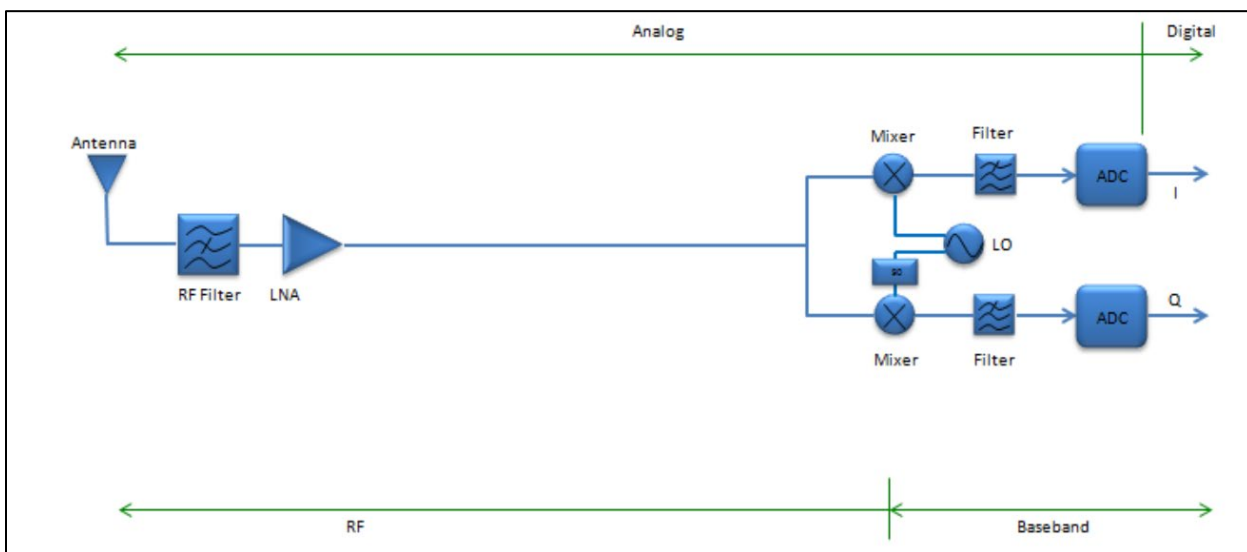
RF front end circuit is implemented to increase the SNR of demodulated signal. The RF front end circuit generally consists of amplifiers, local oscillator, filters and mixers. The output from the mixer is generally fed to an analog-to-digital converter (ADC). This RF front end circuit generally lies at the start of the demodulation process.

The technique to combat a low  $\text{SNR}_{\text{demod\_in}}$  is by adding a front end block, which processes (conditions) the received signal/AWGN/interference before admitting it to the demodulator. This processing can be done in several ways:

(Source: VLSI for Wireless Communication)



(Source: VLSI for Wireless Communication)



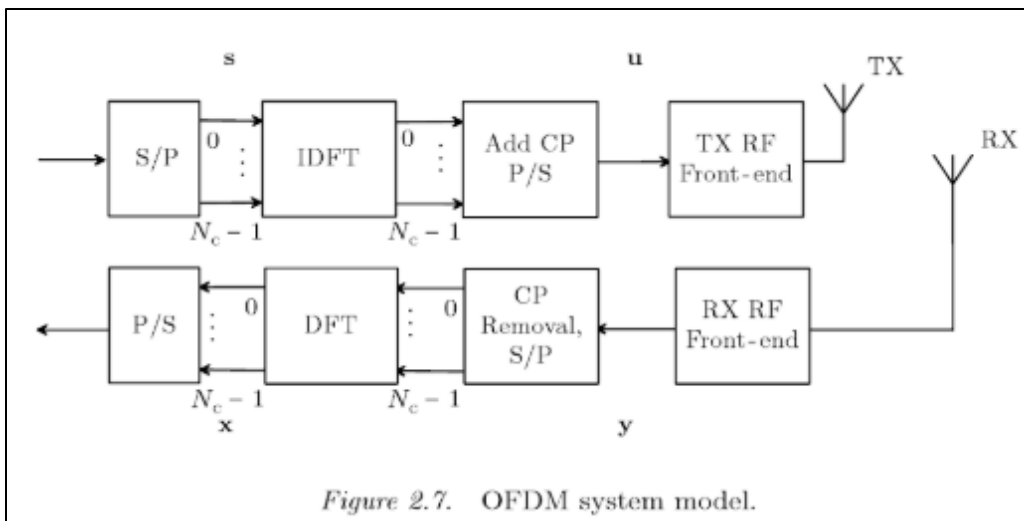


(Source: [http://www.sharetechnote.com/html/RF\\_Introduction.html](http://www.sharetechnote.com/html/RF_Introduction.html))

## 2.4 Rest of Receiver Front End: Nonidealities and Design Parameters

Now that we have talked about the design of filters in the receiver front, we turn our attention to the design of the rest of the components. Normally these components consist of circuits such as LNA, mixer, IF amplifier, and analog/digital (A/D) converter. Unlike filters, their relevant design parameters are different. Hence our first task is to discuss these design parameters.

(Source: VLSI for Wireless Communication)



(Source: RF Imperfections in High-rate Wireless Systems: Impact and Digital Compensation, Schenk (2008))

The RF front end is generally defined as everything between the antenna and the digital baseband system. For a receiver, this "between" area includes all the filters, low-noise amplifiers (LNAs), and down-conversion mixer(s) needed to process the modulated signals received at the antenna into signals suitable for input into the baseband analog-to-digital converter (ADC). For this reason, the RF front end is often called the analog-to-digital or RF-to-baseband portion of a receiver.



(Source: [https://www.eetimes.com/document.asp?doc\\_id=1276331](https://www.eetimes.com/document.asp?doc_id=1276331))

49. The accused products include the synchronization circuit having one input connected to an output of the ADC. According to the LTE standards, the physical layer performs various functions which include frequency and time synchronization. The procedure of achieving this time and frequency synchronizations is called 'Cell Search'. Hence, there are synchronization circuits for performing these functions. The synchronization circuit is connected to an ADC.

The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. The physical layer is expected to perform the following functions in order to provide the data transport service:

- Error detection on the transport channel and indication to higher layers
- FEC encoding/decoding of the transport channel
- Hybrid ARQ soft-combining
- Rate matching of the coded transport channel to physical channels
- Mapping of the coded transport channel onto physical channels
- Power weighting of physical channels
- Modulation and demodulation of physical channels
- Frequency and time synchronisation
- Radio characteristics measurements and indication to higher layers

(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136201/10.00.00\\_60/ts\\_136201v100000p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/10.00.00_60/ts_136201v100000p.pdf))

## 4.1 Cell search

Cell search is the procedure by which a UE acquires time and frequency synchronization with a cell and detects the physical layer Cell ID of that cell. E-UTRA cell search supports a scalable overall transmission bandwidth corresponding to 6 resource blocks and upwards.

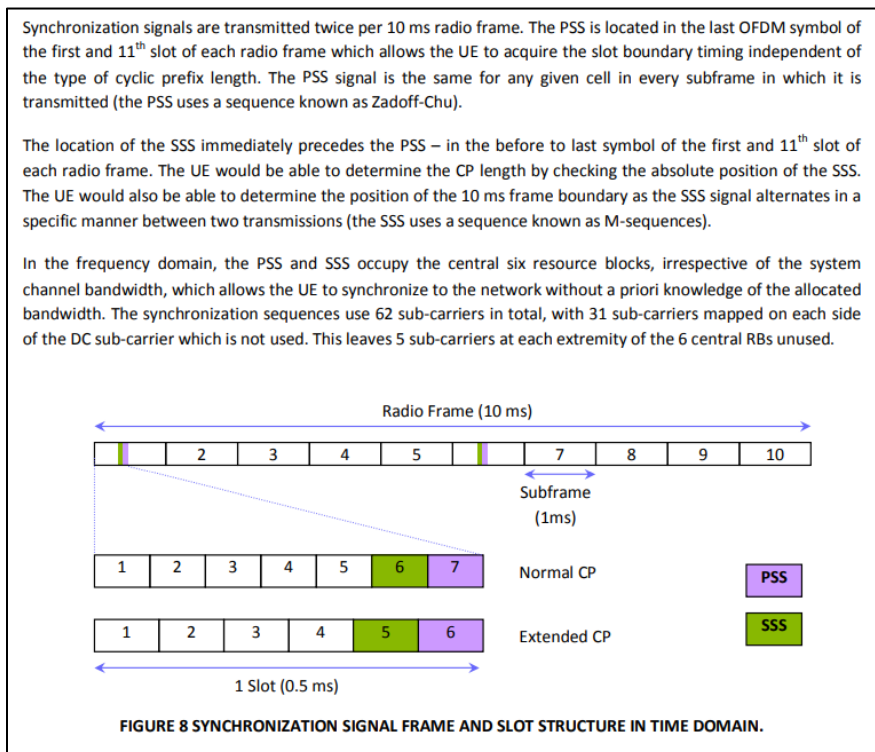
The following signals are transmitted in the downlink to facilitate cell search: the primary and secondary synchronization signals.

A UE may assume the antenna ports 0 – 3 and the antenna port for the primary/secondary synchronization signals of a serving cell are quasi co-located (as defined in [3]) with respect to Doppler shift and average delay.

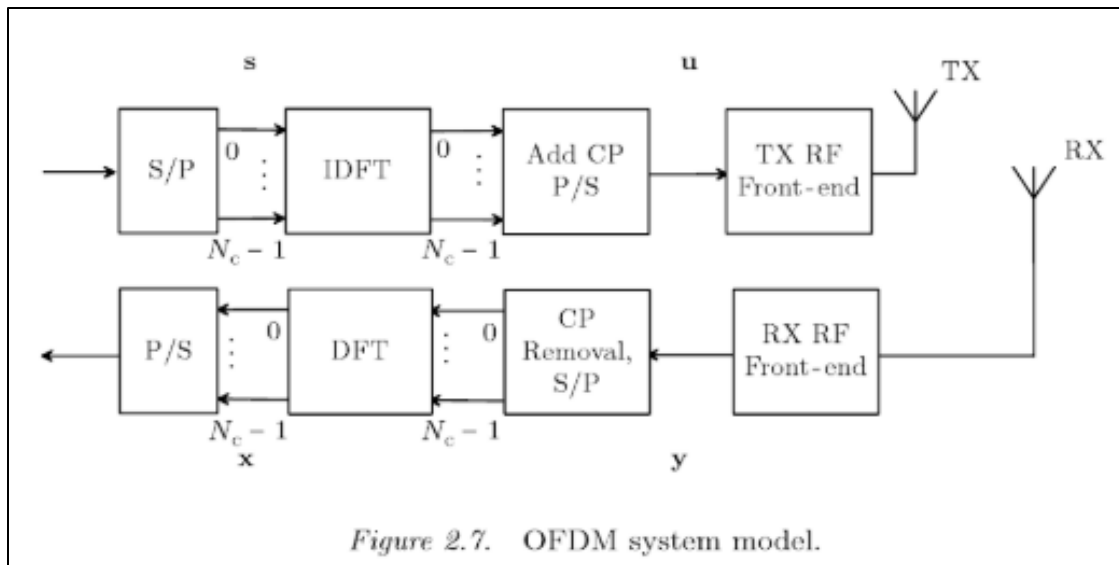
(Source:

[https://www.etsi.org/deliver/etsi\\_ts/136200\\_136299/136213/14.02.00\\_60/ts\\_136213v140200p.pdf](https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/14.02.00_60/ts_136213v140200p.pdf))

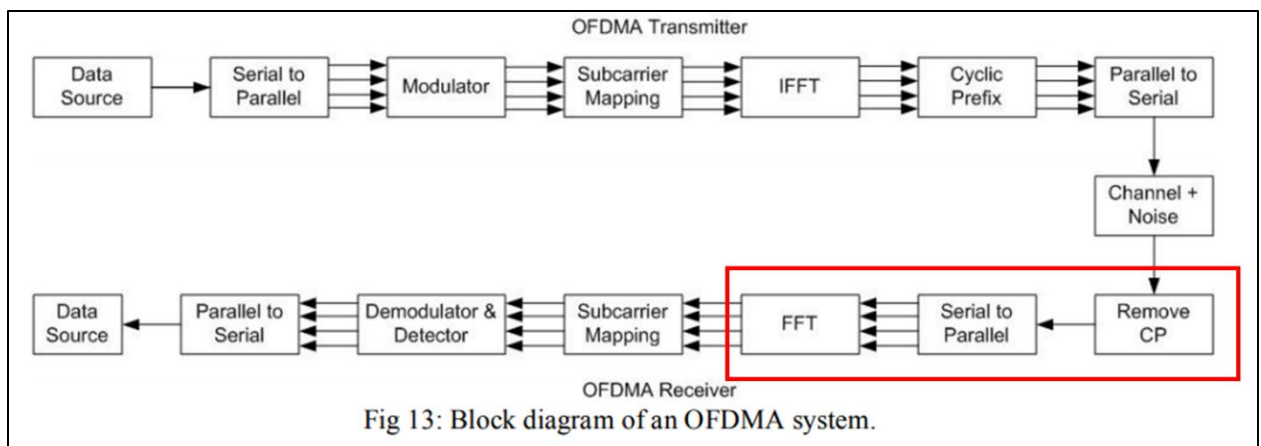
50. The accused products include a cyclic-prefix remover connected to an output of the synchronization circuit, a serial-to-parallel converter connected to an output of the cyclic prefix remover, and a discrete Fournier transform (DFT) stage connected to an output of the serial-to-parallel converter, an output of the DFT stage connected to another input to the synchronization circuit. Cyclic prefixes are added in the preamble for each transmitted frame. In a general OFDM system, a cyclic prefix remover circuit would be present at the receiver end. The output from the cyclic prefix remover circuit is fed to a serial-to-parallel converter for performing a DFT operation on its output.



(Source: <https://home.zhaw.ch/kunr/NTM1/literatur/LTE%20in%20a%20Nutshell%20-%20Physical%20Layer.pdf>)



(Source: RF Imperfections in High-rate Wireless Systems: Impact and Digital Compression, Schenk, Tim)



(Source: <http://ijettjournal.org/volume-12/number-2/IJETT-V12P214.pdf>)

51. Sonim has had knowledge of the '458 Patent at least as of the date when it was notified of the filing of this action.

52. American Patents has been damaged as a result of the infringing conduct by Sonim alleged above. Thus, Sonim is liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

53. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '458 Patent.

**COUNT IV**

**DIRECT INFRINGEMENT OF U.S. PATENT NO. 6,847,803**

54. On January 25, 2005, United States Patent No. 6,847,803 ("the '803 Patent") was duly and legally issued by the United States Patent and Trademark Office for an invention entitled "Method for Reducing Interference in a Receiver."

55. American Patents is the owner of the '803 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the '803 Patent against infringers, and to collect damages for all relevant times.


56. Sonim made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Sonim XP8, Sonim XP7, and Sonim XP5s families of products, that include 802.11ac beamforming capabilities ("accused products"):

Meet Sonim XP8

## Smart for work because it's built to last

Serving, protecting and providing for others demands a smart device you can rely on. Sonim XP8 is the ultra-reliable, ultra-rugged smartphone that's built to provide those who serve with the smart communication they need, regardless of situation or environment.

[Watch Video](#)


 A black Sonim XP8 smartphone is shown lying on a heavily rusted, metallic surface. The phone's screen is on, displaying a search bar at the top, a grid of app icons (Email, Photos, Maps, Play Store, Phone, Messages, Chrome, and an app drawer icon) below, and a dock at the bottom with icons for Phone, Messages, Chrome, and an app drawer. To the right of the phone, there are several metal bolts and nuts. In the bottom right corner of the image, there is a red and white badge that reads "3 YEAR COMPREHENSIVE WARRANTY".

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

### Chipset

Snapdragon 630 OctaCore @ 2.2GHz 64bit

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

### Wi-Fi

**Wi-Fi Standards:** 802.11ac Wave 2, 802.11a/b/g, 802.11n

**Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz

**Peak Speed:** 433 Mbps

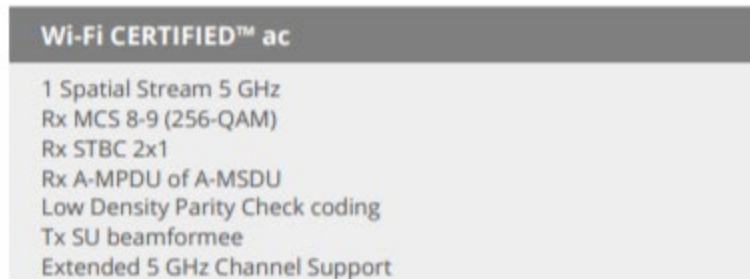
**Channel Utilization:** 20/40/80 MHz

**MIMO Configuration:** 1x1 (1-stream)

**Peak QAM:** 256 QAM

**Wi-Fi Features:** MU-MIMO, Integrated baseband

(Source : <https://www.qualcomm.com/products/snapdragon-630-mobile-platform>)



(Source : screenshot of PDF downloaded from <http://certifications.prod.wifi.org/pdf/certificate/public/download?cid=WFA75610>)

## Sonim XP7

The Sonim XP7 is the cornerstone of Sonim's Mission Critical Solution. An ultra- rugged, LTE/WiFi/Android smartphone, the XP7 is outfitted with unrivaled features such as a touch screen that can be viewed in direct sunlight and easily used with dirty or wet work gloves.

An extra loud speaker, noise cancellation, powerful battery, resistance to drops and water and a 3-Year comprehensive warranty are just some features of the XP7 that provide peace of mind to enterprises and workers alike.

Access to vertical enterprise worker safety and productivity applications as well as a full suite of industrial-grade accessories completes the solution. In extreme and often dangerous working environments where every step is critical, you don't settle for less than the best – Sonim XP7.

**Inquire Now**



(Source : <https://www.sonimtech.com/products/devices/xp7/>)

### Chipset

MSM8926 1.2 GHz Quad core

(Source : <https://www.sonimtech.com/products/devices/xp7/>)



## Wi-Fi

**Wi-Fi Standards:** 802.11ac Wave 2, 802.11a/b/g, 802.11n

**Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz

**Peak Speed:** 150 Mbps

**Channel Utilization:** 20/40/80 MHz

**MIMO Configuration:** 1x1 (1-stream)

**Peak QAM:** 256 QAM

**Wi-Fi Features:** MU-MIMO, Integrated baseband


(Source : <https://www.qualcomm.com/products/snapdragon-processors-400>)

Introducing the Sonim XP5s

## Handset communication pushed to the extreme

Meet the next generation ultra-rugged device built for mission critical communication. Industrial strength. Military tested. The XP5s meets the toughest performance standards to deliver clear, crisp communication wherever work takes you. With built-for-work features that ensure the job gets done right.

[Watch Video](#)



(Source : <https://www.sonimtech.com/products/devices/xp5s/>)

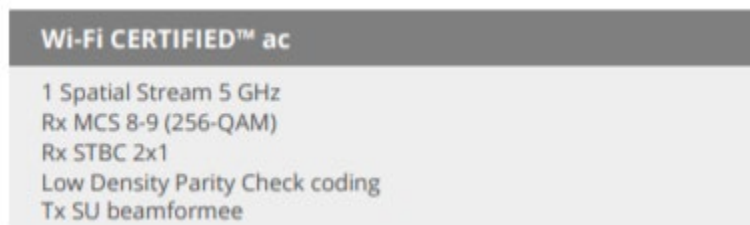
## Chipset

MSM8920 Quad core 1.4GHz

(Source : <https://www.sonimtech.com/products/devices/xp5s/>)

**Wi-Fi****Wi-Fi Standards:** 802.11ac Wave 2, 802.11a/b/g, 802.11n**Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz**Peak Speed:** 433 Mbps**Channel Utilization:** 20/40/80 MHz**MIMO Configuration:** 1x1 (1-stream)**Peak QAM:** 256 QAM**Wi-Fi Features:** MU-MIMO, Integrated baseband

(Source : <https://www.qualcomm.com/products/snapdragon-427-mobile-platform>)



(Source : screenshot of PDF downloaded from <http://certifications.prod.wi-fi.org/pdf/certificate/public/download?cid=WFA74851>)

## Beamforming and MU-MIMO

Beamforming is key for the support of multiuser MIMO, or [MU-MIMO](#), which is becoming more popular as 802.11ax routers roll out. As the name implies, MU-MIMO involves multiple users that can each communicate to multiple antennas on the router. MU-MIMO [uses beamforming](#) to make sure communication from the router is efficiently targeted to each connected client.

(Source: <https://www.networkworld.com/article/3445039/beamforming-explained-how-it-makes-wireless-communication-faster.html>)

57. By doing so, Sonim has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '803 Patent.

58. Sonim has infringed the '803 Patent by using the accused products and thereby practicing a method for reducing interference in a receiver for receiving information in receiving time slots, in which receiver signals are received with at least a first antenna (ANT1) and a second antenna (ANT2). For example, the accused products are used by Sonim to implement the IEEE 802.11-2016 Standard. Devices that can communicate using 802.11 protocol are known as Stations (STAs). Multiple Input Multiple Output (MIMO) and Beamforming techniques are used by a STA with multiple antennas for steering the signals to each STA ("receiver") for reception. In such MIMO transmissions, the space-time streams in the transmitted signal would be intended for reception by each STA in its corresponding time slots. These time slots at which the STA receives the space-time streams with actual data information can be construed as receiving time slots. Since, there are multiple antennas, when they transmit simultaneously, the signal appears as interference at each of the receive antennas. Further, a STA will also be able to identify the space-time streams intended for other STAs that act as interference. STA uses the channel state information that is obtained by estimating a channel to reduce the interference caused by other space time streams. The beamforming calibration procedures ("method for reducing interference") involves channel estimation and matrix calculations which help in reducing the interference in a receiver. Indeed, the IEEE 802.11-2016 Standard shows MIMO systems with two STAs (i.e., STA A and STA B) using multiple antennas ("a first antenna (ANT1) and a second antenna (ANT2)") for receiving transmitted signals.

**21.3.11.1 General**

SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA. With DL-MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs.

(Source : IEEE 802.11-2016 Standard, p. 2578)

**19.3.12 Beamforming****19.3.12.1 General**

Beamforming is a technique in which the beamformer utilizes the knowledge of the MIMO channel to generate a steering matrix  $Q_k$  that improves reception in the beamformee.

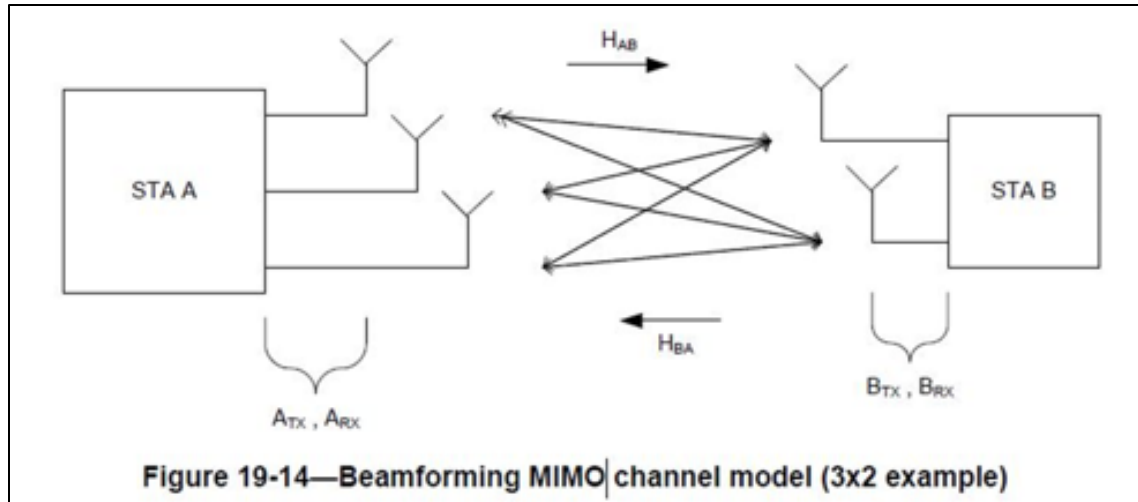
(Source : IEEE 802.11-2016 Standard, p. 2392)

A STA is also able to identify the space-time streams intended for other STAs that act as interference. VHT-LTF symbols in the VHT MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, the STA may use the channel state information for all space-time streams to reduce the effect of interfering space-time streams.

(Source : IEEE 802.11-2016 Standard, p. 2580)

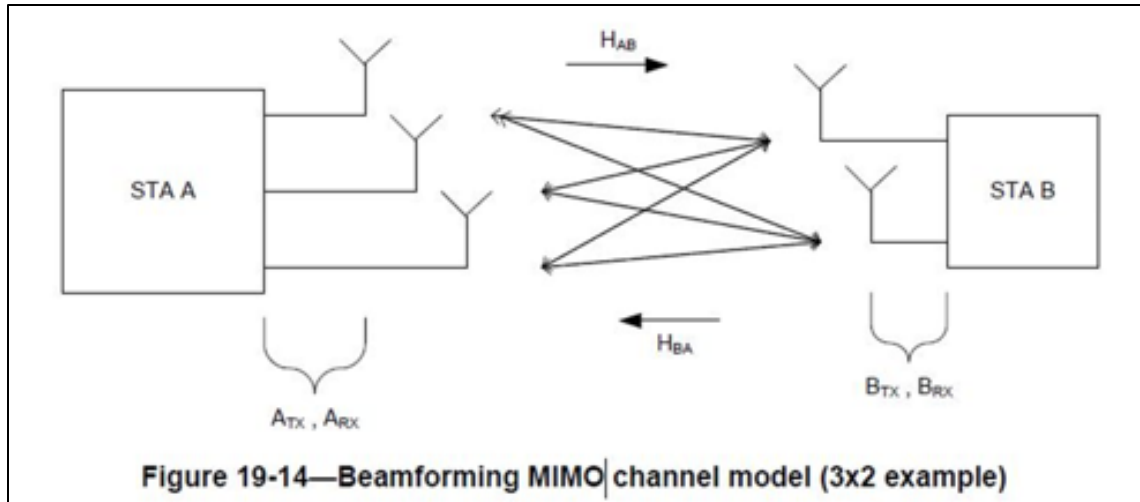
**(2) (STation)** A client device in an 802.11 (Wi-Fi) wireless network such as a computer, laptop or smartphone. The term STA is sometimes used for the access point (AP) as well, in which case a STA is any device communicating via the 802.11 protocol. See wireless LAN and access point.

(Source : <https://www.pcmag.com/encyclopedia/term/sta>)



(Source : IEEE 802.11-2016 Standard, p. 2393)

59. The methods practiced by Sonim's use of the accused products include methods where signals are received with said first antenna (ANT1) and second antenna (ANT2) at moments of time other than in said receiving time slot, when no information is being received. For example, the accused products are used by Sonim to implement the IEEE 802.11-2016 Standard. A STA in that Standard transmits data in PHY Protocol Data Units (PPDUs). PPDUs can be transmitted in High Throughput (HT) mode and Very High Throughput (VHT) mode. A Null Data Packet (NDP) can be transmitted in both HT and VHT Modes. Training Fields (TFs) inside the NDP carry no data related information and can be used as sounding PPDUs in beamforming calibration procedures. Sounding PPDUs would help in channel estimation at the STA. Certain TFs include the interference information which is used as reference during calibration procedures. The NDPs ("signals received") in HT-PPDU and VHT PPDU format includes several TFs which are used as a reference for the receiver to perform calibration/tuning. Thus, there is no actual data information that is received during the beamforming calibration procedures ("at moments of time other than in said receiving time slots").



(Source : IEEE 802.11-2016 Standard, p. 2393)

Table 19-5—Elements of the HT PPDU	
Element	Description
L-STF	Non-HT Short Training field
L-LTF	Non-HT Long Training field
L-SIG	Non-HT SIGNAL field
HT-SIG	HT SIGNAL field
HT-STF	HT Short Training field
HT-GF-STF	HT-Greenfield Short Training field
HT-LTF1	First HT Long Training field (Data)
HT-LTFs	Additional HT Long Training fields (Data and Extension)
Data	The Data field includes the PSDU

(Source : IEEE 802.11-2016 Standard, p. 2347)



**Table 21-4—Fields of the VHT PPDU**

Field	Description
L-STF	Non-HT Short Training field
L-LTF	Non-HT Long Training field
L-SIG	Non-HT SIGNAL field
VHT-SIG-A	VHT Signal A field
VHT-STF	VHT Short Training field
VHT-LTF	VHT Long Training field
VHT-SIG-B	VHT Signal B field
Data	The Data field carrying the PSDU(s)

The VHT-SIG-A, VHT-STF, VHT-LTF, and VHT-SIG-B fields exist only in VHT PPDU. In a VHT NDP the Data field is not present. The number of symbols in the VHT-LTF field,  $N_{VHTLTF}$ , can be either 1, 2, 4, 6, or 8 and is determined by the total number of space-time streams across all users being transmitted in the VHT PPDU (see Table 21-13).

(Source : IEEE 802.11-2016 Standard, p. 2514)

In both HT-mixed format and HT-greenfield format frames, there are two types of HT-LTFs: Data HT-LTFs (HT-DLTFs) and Extension HT-LTFs (HT-ELTFs). HT-DLTFs are always included in HT PPDU to provide the necessary reference for the receiver to form a channel estimate that allows it to demodulate the data

(Source : IEEE 802.11-2016 Standard, p. 2347)

**null data packet (NDP):** A physical layer (PHY) protocol data unit (PPDU) that carries no Data field.

**off-channel:** A channel used by a tunneled direct link setup (TDLS) station (STA) that does not overlap the channel(s) used by the access point (AP) with which the TDLS STA is associated.

(Source : IEEE 802.11-2016 Standard, p. 157)

**sounding physical layer (PHY) protocol data unit (PPDU):** A PPDU that is intended by the transmitting station (STA) to enable the receiving STA to estimate the channel between the transmitting STA and the receiving STA. The Not Sounding field in the High Throughput SIGNAL field (HT-SIG) is equal to 0 in sounding PPDU.

(Source : IEEE 802.11-2016 Standard, p. 163)

**21.3.12 VHT preamble format for sounding PPDU**

NDP is the only VHT sounding format.

The format of a VHT NDP PPDU is shown in Figure 21-28.



**Figure 21-28—VHT NDP format**

NOTE—The number of VHT-LTF symbols in the NDP is determined by the SU NSTS field in VHT-SIG-A.

The VHT NDP PPDU has the following properties:

- Uses the VHT PPDU format but without the Data field.
- Is a VHT SU PPDU as indicated by the VHT-SIG-A field.
- Has the data bits of the VHT-SIG-B field set to a fixed bit pattern (see 21.3.8.3.6).

(Source : IEEE 802.11-2016 Standard, p. 2580)

**10.34 Null data packet (NDP) sounding****10.34.1 HT NDP sounding protocol**

Sounding may be accomplished using either staggered sounding PPDU or HT NDP, as described in 19.3.13. The MAC rules associated with sounding using HT NDP are described in 10.34.1 to 10.34.4.

(Source : IEEE 802.11-2016 Standard, p. 1485)

60. The methods practiced by Sonim's use of the accused products include methods in which a reference signal representing interference in said other time slot is formed and used for the tuning of the receiver in said receiving time slots. For example, the accused products are used by Sonim to implement the IEEE 802.11-2016 Standard. In that Standard, beamforming techniques are used to improve the reception at a receiver STA. These techniques use the channel state information and generate steering matrices for the transmission of data. There are two types of beamforming methods described in the standard, Implicit feedback beamforming and Explicit feedback beamforming. A steering matrix,  $Q_k$ , is calculated in both beamforming methods. Explicit feedback beamforming enables a beamformee i.e., receiving STA to calculate

beamforming feedback matrix based on the received sounding packets/PPDUs. NDPs can be used as sounding PPDUs and hence, no data/information is received during the beamforming procedures. The Standard shows a scenario wherein STA A (transmit STA) transmits a sounding packet (which can be NDP PDU) that is used by STA B (receiving STA) to calculate a beamforming feedback matrix  $V_k$  (“reference signal”). The feedback matrix is later sent to STA A for determining a steering matrix which is used to tune and re-calibrate the receiver STA in order to demodulate the transmitted signal. Implicit feedback beamforming enables STA to estimate a MIMO channel and calculate channel matrices, based on a received sounding PDU. NDPs can be used as sounding PPDUs and hence, no data/information is received during the beamforming procedures. The Standard shows a scenario wherein STA A and STA B (receiving STA) follow beamforming calibration procedures using sounding PPDUs. STA A and STA B will exchange sounding PPDUs (which can be NDP PPDUs), using which each of the STAs will estimate respective channel matrices. Quantized estimates of the channel matrices (“reference signal”) are sent from STA B to STA A. Later, STA A uses its local estimates and the received quantized estimates from STA B to calculate set of correction matrices. These correction matrices that are formed using the received quantized estimates, are applied at transmit side of a STA to correct/tune the amplitude and phase differences in transmit and receive chains. All the above discussed steps are performed as a part of beamforming calibration procedures using sounding PPDUs. The Standard also shows equations for the received signal with beamforming. The channel estimates and beamforming steering matrix are used to tune and re-calibrate the receiver in order to demodulate the transmitted signal.

### 19.3.12 Beamforming

#### 19.3.12.1 General

Beamforming is a technique in which the beamformer utilizes the knowledge of the MIMO channel to generate a steering matrix  $Q_k$  that improves reception in the beamformee.

The equivalent complex baseband MIMO channel model is one in which, when a vector  $\mathbf{x}_k = [x_1, x_2, \dots, x_{N_{TX}}]^T$  is transmitted in subcarrier  $k$ , the received vector  $\mathbf{y}_k = [y_1, y_2, \dots, y_{N_{RX}}]^T$  is modeled as shown in Equation (19-62).

$$\mathbf{y}_k = H_k \mathbf{x}_k + \mathbf{n} \quad (19-62)$$

where

$H_k$  is channel matrix of dimensions  $N_{RX} \times N_{TX}$

$\mathbf{n}$  is white (spatially and temporally) Gaussian noise as illustrated in Figure 19-14

(Source : IEEE 802.11-2016 Standard, p. 2392-2393)

When beamforming is used, the beamformer replaces  $\mathbf{x}_k$ , which in this case has  $N_{STS} \leq N_{TX}$  elements, with  $Q_k \mathbf{x}_k$ , where  $Q_k$  has  $N_{TX}$  rows and  $N_{STS}$  columns, so that the received vector is as shown in Equation (19-63).

$$\mathbf{y}_k = H_k Q_k \mathbf{x}_k + \mathbf{n} \quad (19-63)$$

The beamforming steering matrix that is computed (or updated) from a new channel measurement replaces the existing  $Q_k$  for the next beamformed data transmission. There are several methods of beamforming, differing in the way the beamformer acquires the knowledge of the channel matrices  $H_k$  and on whether the beamformer generates  $Q_k$  or the beamformee provides feedback information for the beamformer to generate  $Q_k$ .

(Source : IEEE 802.11-2016 Standard, p. 2393)

### 19.3.12.3 Explicit feedback beamforming

#### 19.3.12.3.1 General

In explicit beamforming, in order for STA A to transmit a beamformed packet to STA B, STA B measures the channel matrices and sends STA A either the effective channel,  $H_{eff,k}$ , or the beamforming feedback matrix,  $V_k$ , for STA A to determine a steering matrix,  $Q_{steer,k} = Q_k V_k$ , with  $V_k$  found from  $H_k Q_k$ , where  $Q_k$  is the orthonormal spatial mapping matrix that was used to transmit the sounding packet that elicited the  $V_k$  feedback. The effective channel,  $H_{eff,k} = H_k Q_k$ , is the product of the spatial mapping matrix used on transmit with the channel matrix. When new steering matrix  $Q_{steer,k}$  is found,  $Q_{steer,k}$  may replace  $Q_k$  for the next beamformed data transmission.

NOTE— $Q_{steer,k}$  is a mathematical term to update a new steering matrix for  $Q_k$  in the next beamformed data transmission.

(Source : IEEE 802.11-2016 Standard, p. 1477)

### 10.32.3 Explicit feedback beamforming

The procedures in this subclause apply only to HT and non-HT PPDU for which the HT Control field, if present, is the HT variant HT Control field.

In this subclause, the terms *HT beamformer* and *HT beamformee* refer to STAs that are involved in explicit feedback beamforming.

An HT beamformer uses the feedback response that it receives from the HT beamformee to calculate a beamforming feedback matrix for transmit beamforming. This feedback response may have one of three formats:

- *CSI*: The HT beamformee sends the MIMO channel coefficients to the HT beamformer.
- *Noncompressed beamforming*: The HT beamformee sends calculated beamforming feedback matrices to the HT beamformer.
- *Compressed beamforming*: The HT beamformee sends compressed beamforming feedback matrices to the HT beamformer.

(Source : IEEE 802.11-2016 Standard, p. 1477)

### 10.34 Null data packet (NDP) sounding

#### 10.34.1 HT NDP sounding protocol

Sounding may be accomplished using either staggered sounding PPDU or HT NDP, as described in 19.3.13. The MAC rules associated with sounding using HT NDP are described in 10.34.1 to 10.34.4.

(Source : IEEE 802.11-2016 Standard, p. 1477)

### 10.34.5 VHT sounding protocol

#### 10.34.5.1 General

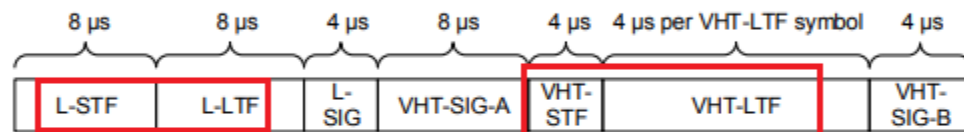
Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the *VHT beamformer*, and a STA for which reception is optimized is called a *VHT beamformee*. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix.

(Source : IEEE 802.11-2016 Standard, p. 1477)

#### 21.3.12 VHT preamble format for sounding PPDU

NDP is the only VHT sounding format.

The format of a VHT NDP PPDU is shown in Figure 21-28.



**Figure 21-28—VHT NDP format**

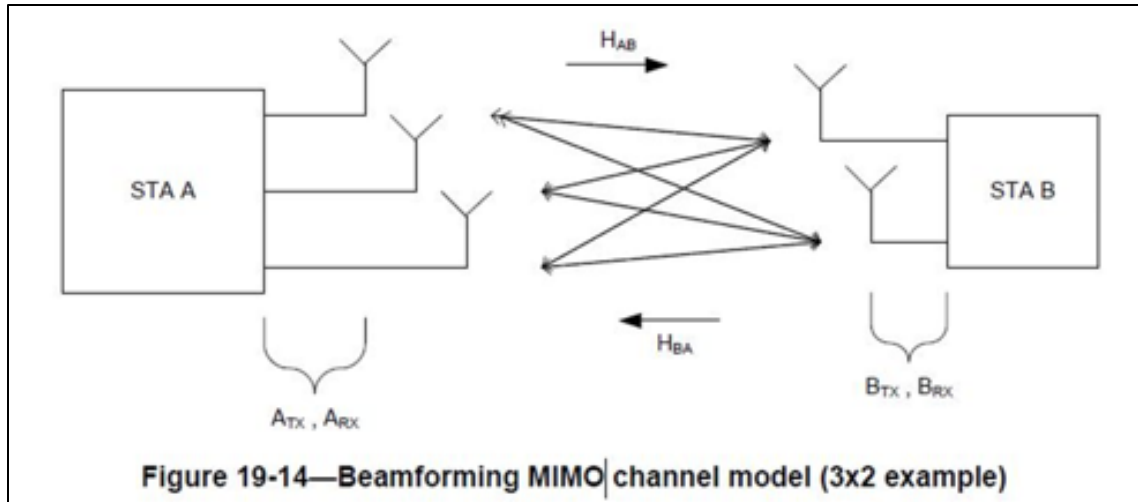
NOTE—The number of VHT-LTF symbols in the NDP is determined by the SU NSTS field in VHT-SIG-A.

The VHT NDP PPDU has the following properties:

- Uses the VHT PPDU format but without the Data field.
- Is a VHT SU PPDU as indicated by the VHT-SIG-A field.
- Has the data bits of the VHT-SIG-B field set to a fixed bit pattern (see 21.3.8.3.6).

(Source : IEEE 802.11-2016 Standard, p. 2580)





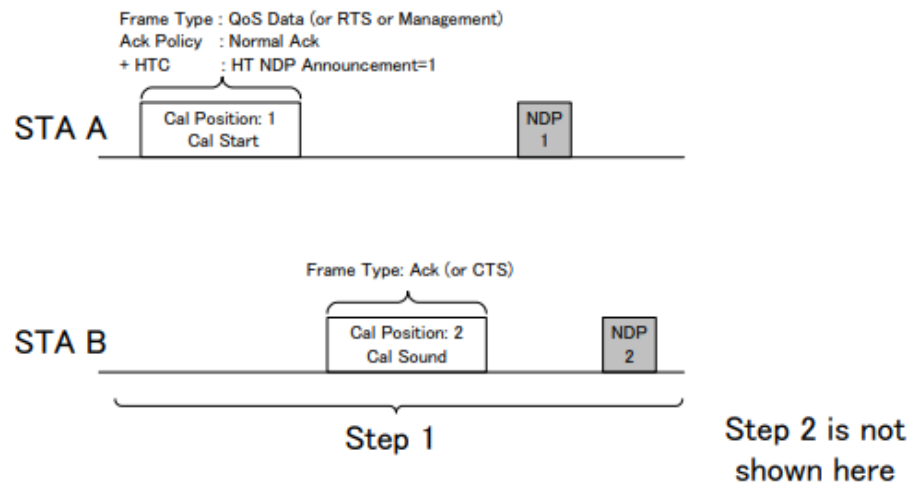
(Source : IEEE 802.11-2016 Standard, p. 2393)

Focusing on STA A, the procedure for estimating  $K_{A,k}$  is as follows:

- a) STA A sends STA B a sounding PPDU, the reception of which allows STA B to estimate the channel matrices  $\tilde{H}_{AB,k}$ .
- b) STA B sends STA A a sounding PPDU, the reception of which allows STA A to estimate the channel matrices  $\tilde{H}_{BA,k}$ .
- c) STA B sends the quantized estimates of  $\tilde{H}_{AB,k}$  to STA A.
- d) STA A uses its local estimates of  $\tilde{H}_{BA,k}$  and the quantized estimates of  $\tilde{H}_{AB,k}$  received from STA B to compute the correction matrices  $K_{A,k}$ .

(Source : IEEE 802.11-2016 Standard, p. 2395)

Figure 10-48 and Figure 10-49 illustrate the calibration PPDU exchange using NDPs.



**Figure 10-48—Calibration procedure with NDP**

(Source : IEEE 802.11-2016 Standard, p. 1475)

### 21.3.12 VHT preamble format for sounding PPDU

NDP is the only VHT sounding format.

The format of a VHT NDP PPDU is shown in Figure 21-28.



**Figure 21-28—VHT NDP format**

NOTE—The number of VHT-LTF symbols in the NDP is determined by the SU NSTS field in VHT-SIG-A.

The VHT NDP PPDU has the following properties:

- Uses the VHT PPDU format but without the Data field.
- Is a VHT SU PPDU as indicated by the VHT-SIG-A field.
- Has the data bits of the VHT-SIG-B field set to a fixed bit pattern (see 21.3.8.3.6).

(Source : IEEE 802.11-2016 Standard, p. 2580)

While the over-the-air channel between the antenna(s) at one STA and the antenna(s) at a second STA is reciprocal, the observed baseband-to-baseband channel used for communication might not be, as it includes the transmit and receive chains of the STAs. Differences in the amplitude and phase characteristics of the transmit and receive chains associated with individual antennas degrade the reciprocity of the over-the-air channel and cause degradation of performance of implicit beamforming techniques. The over-the-air calibration procedure described in 10.32.2.4 may be used to restore reciprocity. The procedure provides the means for calculating a set of correction matrices that can be applied at the transmit side of a STA to correct the amplitude and phase differences between the transmit and receive chains in the STA. If this correction is done at least at the STA that serves as the beamformer, there is sufficient reciprocity for implicit feedback in the baseband-to-baseband response of the forward link and reverse channel.

(Source : IEEE 802.11-2016 Standard, p. 2394)

### **19.3.13.3 Sounding PPDU for calibration**

In the case of a bidirectional calibration exchange, two STAs exchange sounding PPDU, the exchange of which enables the receiving STA to compute an estimate of the MIMO channel matrix  $H_k$  for each subcarrier  $k$ . In general, in an exchange of calibration messages, the number of spatial streams is less than the number of transmit antennas. In such cases, HT-ELTFs are used. In the case of sounding PPDU for calibration, the antenna mapping matrix shall be as shown in Equation (19-86).

(Source : IEEE 802.11-2016 Standard, p. 2401)

Two preamble formats are defined. For HT-mixed format operation, the preamble has a non-HT portion and an HT portion. The non-HT portion of the HT-mixed format preamble enables detection of the PPDU and acquisition of carrier frequency and timing by both HT STAs and STAs that are compliant with Clause 17 and/or Clause 18. The non-HT portion of the HT-mixed format preamble also consists of the SIGNAL field defined in Clause 17 and is thus decodable by STAs compliant with Clause 17 and Clause 18 as well as HT STAs.

The HT portion of the HT-mixed format preamble enables estimation of the MIMO channel to support demodulation of the HT data by HT STAs. The HT portion of the HT-mixed format preamble also includes the HT-SIG field, which supports HT operation. The SERVICE field is prepended to the PSDU.

(Source : IEEE 802.11-2016 Standard, p. 2346)

### 19.3.12 Beamforming

#### 19.3.12.1 General

Beamforming is a technique in which the beamformer utilizes the knowledge of the MIMO channel to generate a steering matrix  $\mathbf{Q}_k$  that improves reception in the beamformee.

The equivalent complex baseband MIMO channel model is one in which, when a vector  $\mathbf{x}_k = [x_1, x_2, \dots, x_{N_{TX}}]^T$  is transmitted in subcarrier  $k$ , the received vector  $\mathbf{y}_k = [y_1, y_2, \dots, y_{N_{RX}}]^T$  is modeled as shown in Equation (19-62).

$$\mathbf{y}_k = \mathbf{H}_k \mathbf{x}_k + \mathbf{n} \quad (19-62)$$

where

$\mathbf{H}_k$  is channel matrix of dimensions  $N_{RX} \times N_{TX}$

$\mathbf{n}$  is white (spatially and temporally) Gaussian noise as illustrated in Figure 19-14

(Source : IEEE 802.11-2016 Standard, p. 2392-2393)

When beamforming is used, the beamformer replaces  $\mathbf{x}_k$ , which in this case has  $N_{STS} \leq N_{TX}$  elements, with  $\mathbf{Q}_k \mathbf{x}_k$ , where  $\mathbf{Q}_k$  has  $N_{TX}$  rows and  $N_{STS}$  columns, so that the received vector is as shown in Equation (19-63).

$$\mathbf{y}_k = \mathbf{H}_k \mathbf{Q}_k \mathbf{x}_k + \mathbf{n} \quad (19-63)$$

The beamforming steering matrix that is computed (or updated) from a new channel measurement replaces the existing  $\mathbf{Q}_k$  for the next beamformed data transmission. There are several methods of beamforming, differing in the way the beamformer acquires the knowledge of the channel matrices  $\mathbf{H}_k$  and on whether the beamformer generates  $\mathbf{Q}_k$  or the beamformee provides feedback information for the beamformer to generate  $\mathbf{Q}_k$ .

(Source : IEEE 802.11-2016 Standard, p. 2393)

61. American Patents has been damaged as a result of the infringing conduct by Sonim alleged above. Thus, Sonim is liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

62. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the ‘803 Patent.

**COUNT V**

**DIRECT INFRINGEMENT OF U.S. PATENT NO. 7,934,090**

63. On April 26, 2011, United States Patent No. 7,934,090 (“the ‘090 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “System For Securing Inbound And Outbound Data Packet Flow In A Computer Network.”

64. American Patents is the owner of the ‘090 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ‘090 Patent against infringers, and to collect damages for all relevant times.

65. Sonim made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Sonim XP8 and Sonim XP7 families of products, that allow for initiation and/or control of Internet streamed content (“accused products”):

Meet Sonim XP8

## Smart for work because it's built to last

Serving, protecting and providing for others demands a smart device you can rely on. Sonim XP8 is the ultra-reliable, ultra-rugged smartphone that's built to provide those who serve with the smart communication they need, regardless of situation or environment.

[Watch Video](#)


(Source: <https://www.sonimtech.com/products/devices/xp8/>)

### Operation System

Android Oreo (8.1.0)

(Source: <https://www.sonimtech.com/products/devices/xp8/>)

## Sonim XP7

The Sonim XP7 is the cornerstone of Sonim's Mission Critical Solution. An ultra-rugged, LTE/WiFi/Android smartphone, the XP7 is outfitted with unrivaled features such as a touch screen that can be viewed in direct sunlight and easily used with dirty or wet work gloves.

An extra loud speaker, noise cancellation, powerful battery, resistance to drops and water and a 3-Year comprehensive warranty are just some features of the XP7 that provide peace of mind to enterprises and workers alike.

Access to vertical enterprise worker safety and productivity applications as well as a full suite of industrial-grade accessories completes the solution. In extreme and often dangerous working environments where every step is critical, you don't settle for less than the best – Sonim XP7.

[Inquire Now](#)




(Source : <https://www.sonimtech.com/products/devices/xp7/>)

### **Operation System**

**Android 5.1.1 Lollipop®**

(Source : <https://www.sonimtech.com/products/devices/xp7/>)

66. By doing so, Sonim has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '090 Patent.

67. Sonim has infringed the '090 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale systems utilizing a method for providing access to a network resource. For example, Sonim, or a person acting at its direction or control, casts content from a Sonim streaming network node to a first user (television with Chromecast). Sonim streaming network nodes allow first user devices to access network resources. Some first user devices, such as Android TVs and televisions with built-in Chromecast, do not require setup for casting by any device on the same network. Other first user devices, such as standalone Chromecast modules, allow casting by any device on the same network after a first set up. As the network node stores user credentials to various media applications (such as Netflix, YouTube etc.), it is pre-authorized to access network resources.

## A better way to get video, music and games to your TV

Your phone is a simple, powerful remote. Just open the mobile apps you already know and love to quickly access your TV shows and playlists. No new log-ins or downloads required.

Use your phone to search, browse, queue and control the TV from anywhere in the home, and keep using it without disrupting what's playing or draining your battery.

(Source: <https://www.google.com/chromecast/built-in/tv/>)

## Set up your Chromecast device

The Google Home app will walk you through the steps to set up your Chromecast device. This includes Chromecast and Chromecast Ultra.

If you've already set up your Chromecast on a mobile device, you don't need to set it up again on a different mobile device *if all devices are on the same Wi-Fi network*.

(Source:

<https://support.google.com/chromecast/answer/2998456?co=GENIE.Platform%3DAndroid&hl=en>)

## Plug In, Connect, Watch

Can't wait to get casting? I know, there's so much to see. Get started with these simple steps:


### Step 1: Plug in your Chromecast device

[Plug Chromecast](#) into your TV, then connect the USB power cable to your Chromecast. Then either plug the other end of the USB power cable into an open USB port on your TV OR into the included power adapter which you will then plug into a power outlet. **Note:** Only use the provided AC adapter.

### Step 2: Connect your Chromecast device

Double check that the Chromecast and the mobile device, tablet, or laptop you are using to set up Chromecast with are both on the *same Wi-Fi network*.

### Step 3: Download the Google Home app

On your mobile device, tablet, or laptop, [download the Google Home app](#) 

### Step 4: Set up Chromecast

Follow these simple [Chromecast setup instructions](#).

### Step 5: Cast content

Learn how to [cast from Chrome to your TV](#) or cast from Chromecast-enabled apps to your TV.

(Source: <https://support.google.com/chromecast/answer/6006232?hl=en-IN>)



(Source: <https://techcrunch.com/2013/07/24/google-launches-google-cast-sdk-for-ios-android-and-chrome-lets-developers-stream-their-apps-to-chromecast/>)

68. The methods practiced by Sonim's use of the accused products include receiving, at a network node that is pre-authorized to access the network resource, a request to allow a first user to assume an identity of the network node, the network node that is pre-authorized having a plurality of access privileges associated therewith. For example, Sonim, or a person acting at its direction or control, casts content from a Sonim streaming network node to a first user (television with Chromecast). The Sonim network node can receive a request from the Chromecast Products using Multicast DNS (MDNS) protocol to gain access to the network resource (for example, content on media applications such as: YouTube, Netflix, etc.). Once the connection between the Sonim streaming network node and the first user device is established, the first user device receives user access credentials (such as user login credentials to access user accounts on

Netflix, YouTube, etc.) from the network node. This allows the first user device to assume the identity of the network node and access network resources.

Along with new beta firmware for the TP-Link Archer C1200 router (hardware versions 1, 2, and 3), TP-Link engineers published a full explanation of the Google Cast network bug they discovered. Android phones and tablets and Cast-enabled Google apps such as YouTube, Google Play Movies & TV, and Google Photos maintain an active connection to Google Home and Google Chromecast devices via what are called MDNS packets, or "multicast Domain Name Server" packets. MDNS resolves the hostnames of devices (i.e., the network names assigned to those devices) to IP addresses, and is commonly used on local networks that don't have a DNS server. They're normally sent every 20 seconds or so, but when some Google Cast-enabled devices go to sleep, they continue to queue new packets to send until woken up and unlocked. This can cause surges of more than 100,000 packets in a short window — the amount of packets sent is directly proportional to the amount of time the device stays asleep. That causes connectivity issues, of course, but can also crash Wi-Fi routers and affect a number of their core services. The only way to fix it is by rebooting the Wi-Fi router.

(Source: <https://www.xda-developers.com/google-home-chromecast-connectivity-issues/>)

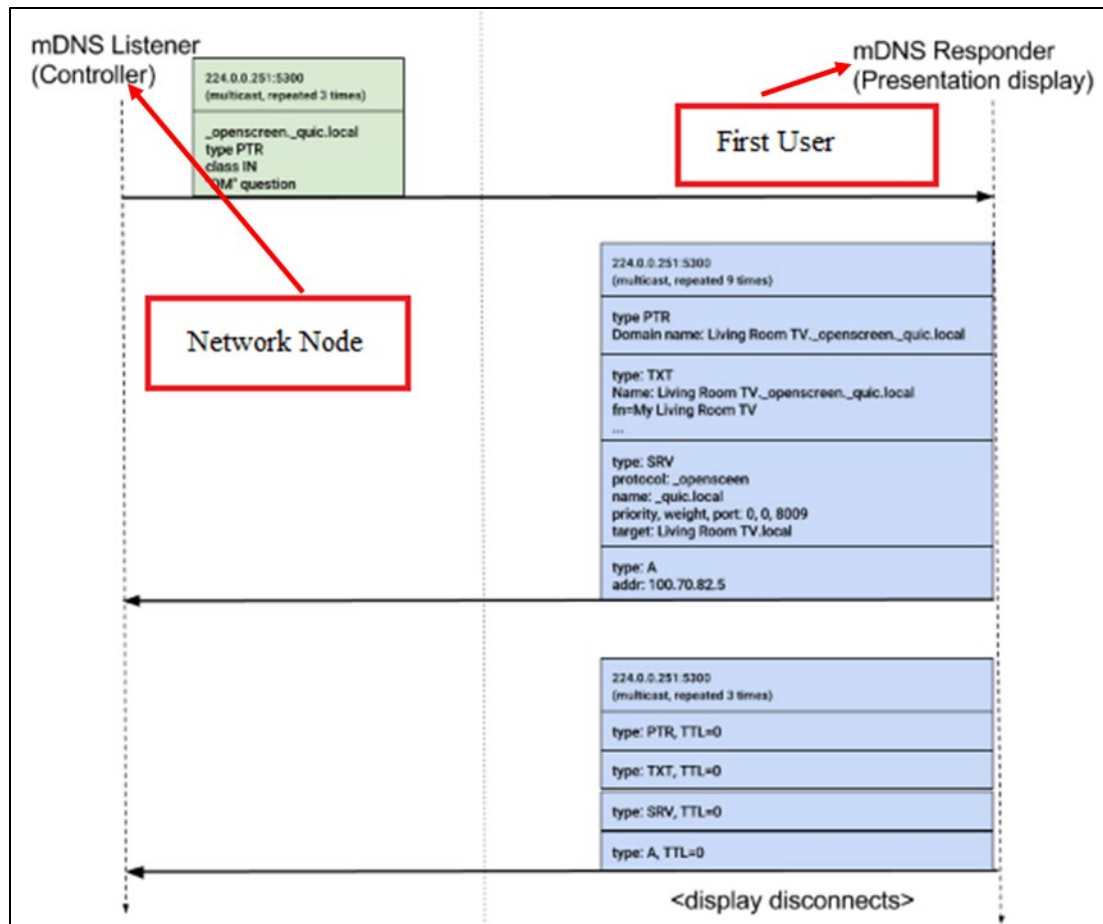
## Multicast DNS / DNS Service Discovery

Multicast DNS (mDNS) and DNS Service Discovery (DNS-SD) are two protocols that work together to discover services over the local area network by extending traditional Internet DNS. (For the rest of this document we use mDNS to refer to both protocols used together.)

mDNS works on a client-server model. Clients (listeners) send multicast DNS queries for records representing service instances, and servers (responders) answer by multicasting matching records that have been registered for each instance including SRV, PTR, TXT and A/AAAA. These records contain addressing information and metadata for instances of the requested service.

Records are sent with a time-to-live (TTL). Listeners may cache records they receive from previous multicasts to answer future queries locally, but should periodically refresh these cached records before the TTL expires.

(Source : <https://webscreens.github.io/openscreenprotocol/mdns.html>)



(Source : <https://webscreens.github.io/openscreenprotocol/mdns.html>)





(Source: <https://techcrunch.com/2013/07/24/google-launches-google-cast-sdk-for-ios-android-and-chrome-lets-developers-stream-their-apps-to-chromecast/>)

69. The methods practiced by Sonim's use of the accused products include allowing the first user to assume the identity of the network node that is pre-authorized, such that the first user appears to the network resource to be the network node that is pre-authorized, after verifying that the first user is authorized. For example, Sonim, or a person acting at its direction or control, casts content from a Sonim streaming network node to a first user device (television with Chromecast). After the Sonim streaming network node verifies that the first user device is a Chromecast-compatible device on the same network, the network node allows the first user device to assume its identity (by sharing the user credentials), thus allowing the first user to access network resources (for example, content on media applications such as: YouTube, Netflix, etc.). The first user device assumes the identity of the network node as it can continue

accessing media from the network resource even if the network node is no longer connected to the first user device.



(Source: <https://techcrunch.com/2013/07/24/google-launches-google-cast-sdk-for-ios-android-and-chrome-lets-developers-stream-their-apps-to-chromecast/>)

You can leave the control screen and browse within the app, go to other apps, let your computer or mobile device go to sleep and even shut it off, and your chosen entertainment should keep playing on the TV via the Chromecast. The latter cannot be done when casting a Chrome tab, but it does work with Netflix and the like.

(Source: <https://electronics.howstuffworks.com/chromecast5.htm>)

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Your phone is a simple, powerful remote. Just open the mobile apps you already know and love to quickly access your TV shows and playlists. No new log-ins or downloads required.

Use your phone to search, browse, queue and control the TV from anywhere in the home, and keep using it without disrupting what's playing or draining your battery.

(Source: <https://www.google.com/chromecast/built-in/tv/>)

## A better way to get video and more to your TV.

With Chromecast, your device is the remote. It's easy to control the TV from anywhere in your home.<sup>2</sup>



Keep using your device  
without interrupting  
what's playing or  
draining your battery.



Tap the Cast button to  
see content on the big  
screen.



Open the apps you  
already know – no new  
logins or downloads  
required.

(Source: [https://store.google.com/product/chromecast\\_2015](https://store.google.com/product/chromecast_2015))

# Unlimited entertainment, on your schedule.

Access TV shows, movies, songs and more through apps<sup>3</sup> like Netflix, YouTube and Google Play.<sup>4</sup>

(Source : [https://store.google.com/product/chromecast\\_2015](https://store.google.com/product/chromecast_2015))

70. The methods practiced by the accused products include, based on the first user assuming the identity of the network node that is pre-authorized, allowing the first user to access the network resource using the plurality of access privileges associated with the network node that is pre-authorized. For example, Sonim, or a person acting at its direction or control, casts content from a Sonim streaming network node to a first user device (television with Chromecast). After verifying that the first user device is a Chromecast-compatible device on the same network, the network node allows the first user device to assume its identity (by sharing the credentials), thus allowing the first user device to access network resources (for example, content on media applications such as: YouTube, Netflix, etc.). The first user device assumes the identity of the network node as it can continue accessing media from the network resource even if the network node is no longer connected to the first user device.



(Source: <https://techcrunch.com/2013/07/24/google-launches-google-cast-sdk-for-ios-android-and-chrome-lets-developers-stream-their-apps-to-chromecast/>)

You can leave the control screen and browse within the app, go to other apps, let your computer or mobile device go to sleep and even shut it off, and your chosen entertainment should keep playing on the TV via the Chromecast. The latter cannot be done when casting a Chrome tab, but it does work with Netflix and the like.

(Source: <https://electronics.howstuffworks.com/chromecast5.htm>)

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Use your phone to search, browse, queue and control the TV from anywhere in the home, and keep using it without disrupting what's playing or draining your battery.

(Source: <https://www.google.com/chromecast/built-in/tv/>)

## A better way to get video and more to your TV.

With Chromecast, your device is the remote. It's easy to control the TV from anywhere in your home.<sup>2</sup>



Keep using your device  
without interrupting  
what's playing or  
draining your battery.



Tap the Cast button to  
see content on the big  
screen.



Open the apps you  
already know – no new  
logins or downloads  
required.

(Source: [https://store.google.com/product/chromecast\\_2015](https://store.google.com/product/chromecast_2015))



Unlimited entertainment, on your  
schedule.

Access TV shows, movies, songs and more through apps<sup>3</sup> like Netflix,  
YouTube and Google Play.<sup>4</sup>

(Source : [https://store.google.com/product/chromecast\\_2015](https://store.google.com/product/chromecast_2015))

71. American Patents only asserts method claims from the ‘090 Patent.

72. American Patents has been damaged as a result of the infringing conduct by Sonim alleged above. Thus, Sonim is liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

73. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the ‘090 Patent.

#### **ADDITIONAL ALLEGATIONS REGARDING INFRINGEMENT**

74. In addition to any specific products mentioned above, the accused products also include at least the following products: Sonim XP8, Sonim XP7, Sonim XP6, Sonim XP5s, Sonim XP3, Sonim Rapid Deployment Kit (RDK), Sonim Smart-Ex 01, Sonim Ex-Handy 209, Sonim Ex-Handy 209A, Sonim Smart-Ex 201, Sonim Smart-Ex 201A, and Sonim XP8800.

75. Sonim has also indirectly infringed the ‘782 Patent, the ‘304 Patent, the ‘458 Patent, the ‘803 Patent, and the ‘090 Patent by inducing others to directly infringe the ‘782 Patent, the ‘304 Patent, the ‘458 Patent, the ‘803 Patent, and the ‘090 Patent. Sonim has induced the end-users, Sonim’s customers, to directly infringe (literally and/or under the doctrine of

equivalents) the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent by using the accused products.

76. Sonim took active steps, directly and/or through contractual relationships with others, with the specific intent to cause them to use the accused products in a manner that infringes one or more claims of the patents-in-suit, including, for example, Claim 30 of the '782 Patent, Claim 1 of the '304 Patent, Claim 1 of the '458 Patent, Claim 1 of the '803 Patent, and Claim 1 of the '090 Patent.

77. Such steps by Sonim included, among other things, advising or directing customers and end-users to use the accused products in an infringing manner; advertising and promoting the use of the accused products in an infringing manner; and/or distributing instructions that guide users to use the accused products in an infringing manner.

78. Sonim has performed these steps, which constitute induced infringement, with the knowledge of the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent and with the knowledge that the induced acts constitute infringement.

79. Sonim was and is aware that the normal and customary use of the accused products by Sonim's customers would infringe the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent. Sonim's inducement is ongoing.

80. Sonim has also induced its affiliates, or third-party manufacturers, shippers, distributors, retailers, or other persons acting on its or its affiliates' behalf, to directly infringe (literally and/or under the doctrine of equivalents) the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent by importing, selling, offering to sell, and/or using the accused products.

81. Sonim has at least a significant role in placing the accused products in the stream of commerce in Texas and elsewhere in the United States.

82. Sonim directs or controls the making of accused products and their shipment to the United States, using established distribution channels, for sale in Texas and elsewhere within the United States.

83. Sonim directs or controls the sale of the accused products into established United States distribution channels, including sales to nationwide retailers.

84. Sonim directs or controls the sale of the accused products nationwide through its own websites as well as in nationwide retailers such as Verizon Wireless and AT&T, including for sale in Texas and elsewhere in the United States, and expects and intends that the accused products will be so sold.

85. Sonim took active steps, directly and/or through contractual relationships with others, with the specific intent to cause such persons to import, sell, or offer to sell the accused products in a manner that infringes one or more claims of the patents-in-suit, including, for example, Claim 30 of the '782 Patent, Claim 1 of the '304 Patent, Claim 1 of the '458 Patent, Claim 1 of the '803 Patent, and Claim 1 of the '090 Patent.

86. Such steps by Sonim included, among other things, making or selling the accused products outside of the United States for importation into or sale in the United States, or knowing that such importation or sale would occur; and directing, facilitating, or influencing its affiliates, or third-party manufacturers, shippers, distributors, retailers, or other persons acting on its or their behalf, to import, sell, offer to sell, and/or use the accused products in an infringing manner.

87. Sonim performed these steps, which constitute induced infringement, with the knowledge of the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent and with the knowledge that the induced acts would constitute infringement.

88. Sonim performed such steps in order to profit from the eventual sale of the accused products in the United States.

89. Sonim's inducement is ongoing.

90. Sonim has also indirectly infringed by contributing to the infringement of the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent. Sonim has contributed to the direct infringement of the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent by the end-user of the accused products.

91. The accused products have special features that are specially designed to be used in an infringing way and that have no substantial uses other than ones that infringe the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent, including, for example, Claim 30 of the '782 Patent, Claim 1 of the '304 Patent, Claim 1 of the '458 Patent, Claim 1 of the '803 Patent, and Claim 1 of the '090 Patent.

92. The special features include improved wireless communication capabilities and initiation and/or control of Internet streamed content used in a manner that infringes the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent.

93. The special features constitute a material part of the invention of one or more of the claims of the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent and are not staple articles of commerce suitable for substantial non-infringing use.

94. Sonim's contributory infringement is ongoing.

95. Furthermore, Sonim has a policy or practice of not reviewing the patents of others (including instructing its employees to not review the patents of others), and thus has been willfully blind of American Patents' patent rights. *See, e.g.*, M. Lemley, "Ignoring Patents," 2008 Mich. St. L. Rev. 19 (2008).

96. Sonim's actions are at least objectively reckless as to the risk of infringing valid patents and this objective risk was either known or should have been known by Sonim.

97. Sonim has knowledge of the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent.

98. Sonim's customers have infringed the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent.

99. Sonim encouraged its customers' infringement.

100. Sonim's direct and indirect infringement of the '782 Patent, the '304 Patent, the '458 Patent, the '803 Patent, and the '090 Patent is, has been, and/or continues to be willful, intentional, deliberate, and/or in conscious disregard of American Patents' rights under the patents.

101. American Patents has been damaged as a result of the infringing conduct by Sonim alleged above. Thus, Sonim is liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

#### **JURY DEMAND**

American Patents hereby requests a trial by jury on all issues so triable by right.

#### **PRAYER FOR RELIEF**

American Patents requests that the Court find in its favor and against Sonim, and that the

Court grant American Patents the following relief:

a. Judgment that one or more claims of the ‘782 Patent, the ‘304 Patent, the ‘458 Patent, the ‘803 Patent, and the ‘090 Patent have been infringed, either literally and/or under the doctrine of equivalents, by Sonim and/or all others acting in concert therewith;

b. A permanent injunction enjoining Sonim and its officers, directors, agents, servants, affiliates, employees, divisions, branches, subsidiaries, parents, and all others acting in concert therewith from infringement of the ‘782 Patent, the ‘304 Patent, and the ‘458 Patent; or, in the alternative, an award of a reasonable ongoing royalty for future infringement of the ‘782 Patent, the ‘304 Patent, and the ‘458 Patent by such entities;

c. Judgment that Sonim account for and pay to American Patents all damages to and costs incurred by American Patents because of Sonim’s infringing activities and other conduct complained of herein, including an award of all increased damages to which American Patents is entitled under 35 U.S.C. § 284;

d. That American Patents be granted pre-judgment and post-judgment interest on the damages caused by Sonim’s infringing activities and other conduct complained of herein;

e. That this Court declare this an exceptional case and award American Patents its reasonable attorney’s fees and costs in accordance with 35 U.S.C. § 285; and

f. That American Patents be granted such other and further relief as the Court may deem just and proper under the circumstances.

Dated: August 26, 2020

Respectfully submitted,

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